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Diversity And Abundance of Flower Visiting Insects on Some Garden Plants in Taldharia, West Bengal, India

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Abstract

Flower-visiting insects are remarkable organisms that play an essential role in the life cycle of flowering plants. These insects, also known as pollinators, engage in complex behaviour with flowers as they seek out nectar or pollen. They travel from one flower to another and indirectly transfer pollen from the anthers to the stigma, allowing fertilisation to occur. In light of this, our study aims to develop a comprehensive dataset regarding the diversity of common flower-visiting insects on selected garden plants in the Taldharia region, West Bengal, India. We selected specific garden plants for this study to observe pollinator insects. A total of sixteen species of insects were observed. To collect insects at random locations within the study sites, both sweep net and hand-picking methods were utilised. The insects found belong to the orders Diptera, Hymenoptera, Lepidoptera, and Coleoptera. Among them, *Lasius niger* was the most abundant, while *Papilio polytes* was found to be the least abundant. Identification was done with the help of literature, books, and museum specimens. This data will be a valuable resource for future studies and will aid in the preservation of the local flora and fauna.

Introduction

Insects that visit flowers are often referred to as flower-visiting insects. They can be characterised as species that directly interact with flowering plants during their life stages. This includes a variety of activities such as foraging for nectar, collecting pollen, and facilitating pollination as they move and transfer pollen from flower to flower, allowing fertilisation to take place (Kearns et al., 1998). Besides pollination, flower-visiting insects may visit flowers for various reasons, including feeding on flower parts, searching for prey, locating their host, or simply resting temporarily on the flower. These interactions play a crucial role in the life cycles of both insects and plants, contributing to the reproductive processes of many flowering species and supporting the overall ecosystem. Flower-visiting insects are known to have a high diversity. Among the most well known flower visiting insects are bees, butterflies, moths, and flies. It is reported that the occurrence of herbaceous blooming plants and flower-visiting insects belongs to the orders Diptera, Coleoptera, Lepidoptera, and Hymenoptera in various urban areas (Matteson et al., 2013). A study conducted in Indonesia further supports it. It was reported that 80% of flower-visiting insects belong to hymenopterans, lepidopterans, and dipterans, highlighting the dominance of these orders in pollination activities (Suhandono et al., 2020). The interaction between flower-visiting insects and flowering plants is crucial for agricultural productivity and biodiversity. About 35% of global food production comes from food crops that rely on animal pollination (Klein et al.,2007). Research indicates that flower-visiting insects are vital for crop yields and contribute to the quality of fruits and seeds, supporting ecosystem functions (Kearns et al.,1998). Studies indicate that the area cultivated with crops dependent on pollinators has significantly increased over the past fifty years, highlighting a growing

reliance on these insects in agriculture (Aizen et al., 2008; Aizen & Harder, 2009). According to Losey and Vaughan (2006), the pollination services provided by flower-visiting insects play a crucial role in global crop production. Many agricultural crops depend on insect pollination. These insects contribute to food webs by serving as pollinators, supporting other wildlife that depend on plants for food and habitat. The health of flower-visiting insect populations can indicate the overall state of the environment. A decline in their populations can signal broader ecological issues, such as habitat degradation or climate change (Potts et al., 2010). Despite their importance, flower visiting insects face numerous threats that endanger their survival. Habitat loss (Mustajarvi et al., 2001; Aguilar et al., 2006), pesticide use (Kremen et al., 2002), and climate change (Memmott et al., 2007; Schweiger et al., 2010; Hegland et al., 2009) are all major factors that can negatively impact these species and the plants they pollinate. To keep our environments healthy and full of diversity, we must protect and preserve these important organisms and their habitat. To maintain a healthy ecosystem, it is important to understand the relationship between plants and insects. Specifically, knowledge of the pollinators in a particular area is crucial for the survival of plant species. In light of this, the objective of our study is to develop a complete dataset concerning the diversity and abundance of flower-visiting insects commonly seen on several garden plants in Taldharia, which is located in the state of West Bengal in India. The information gathered will be a valuable resource for future research and will be helpful to the conservation of the local flora and fauna.

Materials and methods

Field studies were carried out from November 2020 to January 2021 at a garden in Taldharia village in West Bengal. The garden is located at 22.7^0 N latitude and 88.4^0 E longitude at an elevation of 9.75 meters above mean sea level. Various garden plants were randomly selected for observation of flower-visiting insects on them. Some of them were Marigold, Hibiscus, Rose, Jasmine, Bougainvillaea, Oleander, Hydrangea, Petunia, Chrysanthemums, etc. Observations were conducted within one week during the study intervals. The time of observation was 7:00 am to 10:00 am and 3:00 pm to 5:00 pm. During the research period, various insect species were gathered, carefully anaesthetised using chloroform, and brought back to the laboratory for identification. Regular field trips were organised to survey and collect insect samples. To capture insects from random locations within the research sites, both sweep netting and hand-picking methods were employed. After collection, the insects were transferred to a container with 70% alcohol for liquid preservation and phenol for dry preservation to aid in their identification. Identification was carried out using reference literature, guidebooks, and museum specimens, focusing on the insects associated with particular flowering species. Photographic documentation was done by a Nikon Coolpix L120 digital camera and mobile phone camera. Line transect method was adopted to calculate the species abundance. A 30 mt nylon rope was laid in the garden and divided into 5 segments at 6 mt intervals all the way along its length. The number of different species were recorded that touched or crossed the alternate segments of the entire transect line. The abundance of any particular species is stated as a percentage of the total number of species that are present in the community. Thus, it is a relative measurement. When assessing the abundance of species, the actual individuals of each species are tallied rather than merely noting their presence or absence when analysing the frequency of a species. The following formulae of Getis & Franklin (1987) were used for the sampling study.

1. Density = $\frac{Total\ no\ of\ individual\ of\ the\ species}{Total\ no\ of\ transects\ studied}$
2. Abundance = $\frac{\text{Total no of individual of the species}}{\text{No of transect per units in which they occur}}$
3. Relative abundance = $\frac{Total\ no\ of\ individual\ of\ a\ species}{Toal\ no\ of\ individuals\ of\ all\ species\ recorded}$

Results

A total of sixteen species of insects were studied on the different garden plants during the survey period (Table 1). Among sixteen species, seven belong to Lepidoptera; these are *Junonia atlites* (L.), *Danaus chrysippus* (L.), *Acraea terpsicore* (L.), *Tirumala limniace* (Cramer), *Eurema hecabe* (L.), *Delias eucharis* (Drury) and *Papilio polytes* (L.). Five species belong to Hymenoptera; these are *Apis cerana indica* (F.), *Apis florae* (F.), *Polistes wattii* (Cameron), *Oecophylla smaragdina* (F.), and *Lasius niger* (L.). Two species belong to Diptera; these are *Eristalinus tabanoides* (Jaennicke) and *Musca domestica* (L.). Two species belong to Coleoptera; these are *Coccinella transversalis* (F.) and *Epilachna vigintioctopunctata* (F). The result of the transect sampling study revealed that the most abundant species was *Lasius niger* (Black ant) followed by another hymenopteran species *Apis cerana indica* (Indian honeybee). *Musca domestica, Oecophylla smaragdina, Danaus chrysippus,*

Eurema hecabe, Polistes wattii, and *Coccinella transversalis* were found to have a moderate abundance. It is also clear from Table 2 that *Papilio polytes* had the lowest abundance. The Grey Pansy (*Junonia atlites*) is a butterfly species that belongs to the family Nymphalidae. It is predominantly found in various regions across Asia, especially in India, and is known for its distinctive colouration and patterns. Its morphological characteristics include a wingspan of approximately 55-70 mm, with the forewings displaying a mix of brown and grey hues, adorned with eye spots that serve as a defence mechanism against predators. The flight is characterised by a slow, gliding motion, enabling it to navigate through diverse habitats. The Grey Pansy primarily feeds on the nectar of various flowering plants, including species from the Asteraceae and Fabaceae families, serving as a pollinator and contributing to the health of local ecosystems. The Plain Tiger (*Danaus chrysippus*) is a member of the Nymphalidae family and is widely recognised across various continents, particularly in Africa and Asia. Its distinct orange and black wing pattern and adaptability to diverse environments have made it a subject of interest in the fields of ecology, behaviour, and conservation. As detailed by Larsen (2005), the morphological features of the Plain Tiger include its vibrant wings, which exhibit orange colouration adorned with black borders and white spots, serving both as a warning to predators and as a means of sexual selection. The Plain Tiger plays a significant role in pollination, contributing to the reproduction of various flowering plants. Its interactions with flora help maintain ecological balance and support biodiversity. Studies have shown that *Danaus chrysippus* serves as a model organism for understanding plant-insect interactions and the dynamics of food webs**.** The Tawny Coster (*Acraea terpsichore*), a member of the Nymphalidae family, is a vibrant and distinctive butterfly that is primarily found in the tropical and subtropical regions of Asia and parts of Africa. This species is known for its striking orange wings, which feature black spots, and is often observed in gardens, fields, and along roadsides, contributing significantly to local biodiversity and ecosystems. The Tawny Coster plays a significant role in pollination and supports the local ecosystem's health. The Blue Tiger (*Tirumala limniace*) is a striking butterfly belonging to the family Nymphalidae, known for its distinctive blue and black colouration, along with unique patterns on its wings. This species is commonly found in various regions of Asia, including India, Southeast Asia, and some parts of Australia. *Tirumala limniace* plays a vital role in pollination within its habitat, acting as a pollinator for many flowering plants. The Common Grass Yellow (*Eurema hecabe*) is a widely distributed butterfly species belonging to the family Pieridae. Known for its distinctive yellow and black pattern, this butterfly is often spotted in open fields, gardens, and grassy areas across Asia, Africa, and Australia. This species is characterised by its yellow forewings with black margins and varying patterns on its hindwings, which may differ depending on geographical location. *Eurema hecabe* serves a vital role in ecosystems as both a pollinator and a member of the food web. As a pollinator, it contributes to the reproductive success of many flowering plants, enhancing biodiversity in its habitat. The Common Jezebel **(***Delias eucharis*) is a butterfly species belonging to the family Pieridae. It is predominantly found across various regions in Asia, including India, Southeast Asia, and parts of Australia. This species exhibits sexual dimorphism, with males displaying vibrant colours that include bright yellow wings with black borders and a characteristic red spot on the forewings, while females appear more subdued in colouration and are generally greyish or pale yellow with less distinct markings (Matsumoto, 1998). The Common Jezebel plays a pivotal role within its ecosystem as a pollinator and prey species. As an effective pollinator, it aids in fertilising many flowering plants, promoting genetic diversity and healthy plant populations. The Common Mormon (*Papilio polytes*) is a widely distributed butterfly species in the family Papilionidae.Found predominantly in tropical and subtropical regions of Asia, its range extends from India and Southeast Asia to parts of Australia. Common Mormon exhibits sexual dimorphism; males typically have black wings with a characteristic pattern of red and white spots, while females display a wider range of colour variations, often resembling different species, which aids in mimicry and predator evasion (Koh, 1994). By facilitating pollination, these butterflies contribute to the reproductive success of numerous plant species, including economically significant crops (Ghosh & K. H. S. Rahul, 2010). Indian honeybee (*Apis cerana indica*) is classified within the family Apidae, order Hymenoptera. Indian honeybees typically exhibit a small to medium size with a body size ranging from 10 to 15 mm in length. They possess a slightly hairy body, which aids in effective pollen collection. They are known to pollinate a wide range of crops, including fruits, vegetables, and legumes, thus significantly contributing to food security and ecosystem stability (Raju et al., 2014). Research indicates that their foraging behaviour is influenced by the availability of floral resources, weather conditions, and habitat types (Chaudhary, 2016). *Apis florea*, commonly known as the dwarf honeybee, is a small species of honeybee native to Southeast Asia and parts of Africa. *Apis florea* belongs to the family Apidae in the order. The dwarf honeybee is characterised by its small size, typically measuring about 10-11 mm in length. It has a slender body, covered in fine hairs, which aids in the collection of pollen. The colouration is usually a pale yellowish or brown hue with darker bands on the abdomen. Their foraging activities facilitate plant reproduction, which is essential for maintaining biodiversity and ecosystem health (Buchmann & Nabhan,

1996). Research indicates that they are particularly effective pollinators for many tropical fruit species, thus enhancing fruit yield and quality. The Yellow Paper Wasp (*Polistes wattii*) is a social wasp species belonging to the family Vespidae. Commonly found in temperate regions of Europe, North America, and parts of Asia, this species is recognised for its distinctive yellow and black colouration and its characteristic nest-building behaviour. As predators, Yellow Paper Wasps play an essential role in controlling pest populations, primarily by preying on caterpillars and other soft-bodied insects. Their hunting behaviour can contribute significantly to the ecological balance within their habitats. Additionally, they serve as pollinators for some plant species, although this role is less pronounced compared to other insects, such as bees. Red ants (*Oecophylla smaragdina*) are well-known social insects characterised by their reddish colouration and aggressive behaviour. Commonly referred to as fire ants, these ants are distributed widely across the globe. As opportunistic foragers, red ants contribute significantly to soil aeration and nutrient cycling. They act as both predators and prey within their ecosystems. Their predation on various pest insects, such as caterpillars and other soft-bodied invertebrates, can help regulate pest populations, although their presence can sometimes have negative effects on native species and agricultural systems. Hover flies (*Eristalinus tabanoides*), commonly referred to as flower flies or syrphids, belong to the family Syrphidae within the order Diptera. Numerous studies have shown that hover flies can be efficient pollinators for a variety of crops, comparable to, and sometimes exceeding, the effectiveness of bees (Van Rijn et al., 2013). The house fly (*Musca domestica*) is one of the most ubiquitous insect species globally. While often regarded primarily as a nuisance pest and vector of pathogens, recent studies suggest that house flies can play a role in the pollination of certain plants. *Musca domestica* belongs to the family Muscidae in the order Diptera. It is characterised by its grey body, a wide set of large compound eyes, and the ability to adapt to diverse environments. The role of house flies in pollination is particularly significant in certain ecological contexts. Although they are not as efficient as bees, studies have shown that house flies can contribute to plant reproduction, especially for flowers in disturbed habitats where other pollinators may be scarce. Ladybird beetles (*Coccinella transversalis*), commonly known as ladybugs or ladybirds, belong to the family Coccinellidae. They are recognisable by their bright colours and distinctive spotted patterns. Ladybird beetles serve as significant natural predators of aphids and other plant-sucking insects, making them vital components of agricultural ecosystems (Dixon, 2000). The Hadda beetle (*Epilachna vigintioctopunctata*) is a significant pest primarily affecting solanaceous crops like potatoes, tomatoes, and eggplants. They tend to prefer younger plants with high nutrient content, which are essential for larval development (Jones & Smith, 2019). Though beetles are predators but study reported that they are recognised as accidental pollinators.

Sl no	Common Name	Scientific name	Order	Family	Fig
1	Grey pansy	*Junonia atlites* (L.)	Lepidoptera	Nymphalidae	(1a)
2	Plain tiger	*Danaus chrysippus* (L.)	Lepidoptera	Nymphalidae	(1b)
3	Tawny coster	*Acraea terpsicore* (L.)	Lepidoptera	Nymphalidae	(1c)
4	Blue tiger	*Tirumala limniace* (Cramer)	Lepidoptera	Nymphalidae	(1d)
5	Common grass yellow	*Eurema hecabe* (L.)	Lepidoptera	Pieridae	(1e)
6	Common jezebel	*Delias eucharis* (Drury).	Lepidoptera	Pieridae	(1f)
7	Common mormon	*Papilio polytes* (L.).	Lepidoptera	Papilionidae	(1g)
8	Indian honeybee	*Apis cerana indica* (F.)	Hymenoptera	Apidae	(1h)
9	Little honeybee	*Apis florae* (F.)	Hymenoptera	Apidae	(1i)
10	Yellow paper wasp	*Polistes wattii* (Cameron)	Hymenoptera	Vespidae	(1j)
11	Red ants	*Oecophylla smaragdina* (F.).	Hymenoptera	Formicidae	(1k)
12	Black ants	*Lasius niger* (L.)	Hymenoptera	Formicidae	(1l)
13	Hover fly	*Eristalinus tabanoides (Jaennicke)*	Diptera	Syrphidae	(1m)
14	House fly	*Musca domestica* (L.).	Diptera	Muscidae	(1n)
15	Ladybird beetle	*Coccinella transversalis* (F.)	Coleoptera	Coccinellidae	(1o)
16	Hadda beetle	*Epilachna vigintioctopunctata* (F)	Coleoptera	Coccinellidae	(1p)

Table 1. List of flower visiting insects observed during the survey period in Taldharia, West Bengal, India.

Sl no	Name of the species	Total no of individual species touched or crossed the segment	Total no of segments in which the species has occurred	Total no of segments studied	D*	A**	RA***
1	*Junonia atlites* (L.)	11	3	5	2.2	3.6	0.065
2	*Danaus chrysippus* (L.)	16	5	5	3.2	3.2	0.057
3	*Acraea terpsicore* (L.)	9	5	5	1.8	1.8	0.032
4	*Tirumala limniace* (Cramer)	8	4	5	1.6	2.0	0.036
5	*Eurema hecabe* (L.)	14	5	5	2.8	2.8	0.05
6	*Delias eucharis* (Drury).	8	5	5	1.6	1.6	0.028
7	*Papilio polytes* (L.).	5	4	5	1.0	1.2	0.021
8	*Apis cerana indica* (F.)	34	5	5	6.8	6.8	0.122
9	*Apis florae* (F.)	8	3	5	1.6	2.6	0.047
10	*Polistes wattii* (Cameron)	14	5	5	2.8	2.8	0.05
11	*Oecophylla smaragdina* (F.).	18	5	5	3.6	3.6	0.065
12	*Lasius niger* (L.)	65	5	5	13.0	13.0	0.235
13	*Eristalinus tabanoides (Jaennicke)*	7	5	5	1.4	1.4	0.025
14	*Musca domestica* (L.)	25	5	5	5.0	5.0	0.09
15	*Coccinella transversalis* (F.)	12	5	5	2.4	2.4	0.043
16	*Epilachna vigintioctopunctata* (F)	6	4	5	1.2	1.5	0.027

[*D=Density, A= Abundance, RA***= Relative abundance]**

Table 2. Diversity and abundance of insects visiting flowers during the survey period in Taldharia, West Bengal, India.

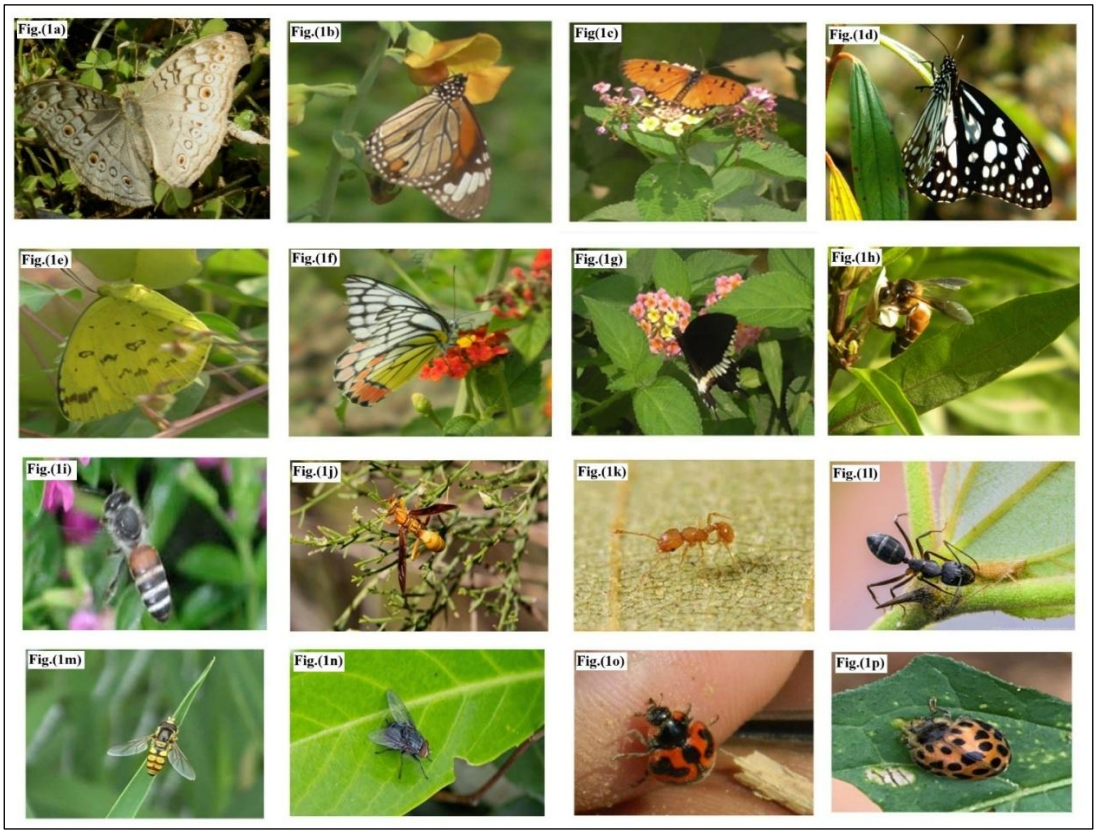

Fig. (1a) *Junonia atlites* (1b) *Danaus chrysippus* (1c) *Acraea terpsicore* (1d) *Tirumala limniace* (1e) *Eurema hecabe* (1f) *Delias eucharis* (1g) *Papilio polytes* (1h) *Apis cerana indica* (1i) *Apis florae* (1j) *Polistes wattii* (1k) *Oecophylla smaragdina* (1l) *Lasius niger* (1m) *Eristalinus tabanoides* (1n) *Musca domestica* (1o) *Coccinella transversalis* (1p) *Epilachna vigintioctopunctata*

Conclusion

It is revealed that a total of 16 insect pollinators belonging to the order Lepidoptera (7), followed by Hymenoptera (5), Coleoptera (2) and Diptera (2), were found to visit the garden plants in surveyed areas. Among them, the black ant (*Lasius niger*), belonging to the order Hymenoptera, was the most abundant, while *Papilio polytes* was found to be the least abundant. The study provides valuable insights into the diversity of pollinator insects on garden plants at Taldharia. It is, therefore, important to protect and conserve these vital creatures and their habitats to ensure the sustained health and diversity of our ecosystems.

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References

1. Kearns, C. A., Inouye, D. W., & Waser, N. M. 1998. Endangered mutualisms: the conservation of plant-pollinator interactions. Annual review of ecology and systematics, 29(1):83-112.
2. Matteson, K. C., Grace, J. B., & Minor, E. S. 2013. Direct and indirect effects of land use on floral resources and flower-visiting insects across an urban landscape. Oikos, 122(5):682-694.
3. Suhandono, S., Sopandi, W., & Yulianda, D. 2020. Diversity of flower-visiting insects in urban and rural areas: A case study from Indonesia. Biodiversitas, 21(4): 1609-1616.
4. Klein, A. M., Vaissière, B. E., Cane, J. H., Steffan-Dewenter, I., Cunningham, S. A., Kremen, C., & Tscharntke, T. 2007. Importance of pollinators in changing landscapes for world crops. Proceedings of the royal society B: biological sciences, 274(1608):303-313.
5. Kearns, C. A., Inouye, D. W., & Waser, N. M. 1998. Endangered mutualisms: the conservation of plant-pollinator interactions. Annual review of ecology and systematics, 29(1):83-112.
6. Aizen, M. A., Garibaldi, L. A., Cunningham, S. A., & Klein, A. M. 2008. Long-term global trends in crop yield and production reveal no current pollination shortage but increasing pollinator dependency. Current biology, 18(20):1572-1575.
7. Aizen, M. A., & Harder, L. D. 2009. The global stock of domesticated honey bees is growing, but wild pollinators are in decline. Trends in Ecology & Evolution, 24(12):689-694.
8. Losey, J. E., & Vaughan, M. 2006. The economic value of ecological services provided by insects. Bioscience, 56(4):311-323.
9. Potts, S. G., Biesmeijer, J. C., Kremen, C., Neumann, P., Schweiger, O., & Kunin, W. E. 2010. Global pollinator declines: trends, impacts and drivers. Trends in ecology & evolution, 25(6):345-353.
10. Mustajärvi, K., Siikamäki, P., Rytkönen, S., & Lammi, A. 2001. Consequences of plant population size and density for plant-pollinator interactions and plant performance. Journal of Ecology, 80-87.
11. Aguilar, R., Ashworth, L., Galetto, L., & Aizen, M. A. 2006. Plant reproductive susceptibility to habitat fragmentation: review and synthesis through a meta-analysis. Ecology letters, 9(8):968-980.
12. Kremen, C., Williams, N. M., & Thorp, R. W. 2002. Crop pollination from native bees at risk from agricultural intensification. Proceedings of the National Academy of Sciences, 99(26):16812-16816.
13. Memmott, J., Craze, P. G., Waser, N. M., & Price, M. V. 2007. Global warming and the disruption of plant–pollinator interactions. Ecology letters, 10(8),:710-717.
14. Schweiger, Oliver, Jacobus C. Biesmeijer, Riccardo Bommarco, Thomas Hickler, Philip E. Hulme, Stefan Klotz, Ingolf Kühn.2010. Multiple stressors on biotic interactions: how climate change and alien species interact to affect pollination. Biological Reviews 85, no. 4 (2010): 777-795.
15. Hegland, S. J., Nielsen, A., Lázaro, A., Bjerknes, A. L., & Totland. 2009. How does climate warming affect plant-pollinator interactions?. Ecology letters, 12(2):184-195.
16. Getis, A., & Franklin, J. 1987. The use of transects in ecological research. Ecological Applications, 6(4):103-116.
17. Larsen, T. B. 2005. Butterflies of West Africa: plate volume, pp 270.
18. Matsumoto, Y. 1998. Sexual dimorphism and mimicry in the Common Jezebel. Journal of Natural History, 32(3).
19. Koh, L. P. 1994. Hybridization and sexual dimorphism in two sympatric swallowtail butterflies. Biological Journal of the Linnean Society, 53(3).

20. Ghosh, S., & K. H. S. Rahul. 2010. The ecological significance of *Papilio polytes* in the ecosystem. Journal of Lepidoptera Research, 35(1).
21. Raju, R., & M. A. Ganesh. 2014. Pollination ecosystem services by *Apis cerana indica*. Biodiversity and Conservation, 23(7).
22. Chaudhary, R. 2016. Foraging behaviour of *Apis cerana indica* in agricultural landscapes. Environmental Entomology, 45(5).
23. Buchmann, S. L., & Nabhan, G. P. 1996. The pollination crisis. The Sciences, 36(4):22-27.
24. van Rijn, P. C., Kooijman, J., & Wäckers, F. L. (2013). The contribution of floral resources and honeydew to the performance of predatory hoverflies (Diptera: Syrphidae). Biological Control, 67(1), 32-38.
25. Dixon, A. F. G. 2000. Insect Predators of Aphids: Biology and Management. Agricultural and Forest Entomology, 2(2):141-150.
26. Jones, T., & Smith, H. 2019. Feeding behaviour of *Leptinotarsa decemlineata* larvae on various solanaceous crops. Crop Protection, 110:20-28.