# Diversity and Ecological Role of Pollinators in Dry Deciduous Forests of Eastern Karnataka

Dr. Muniraju, Assistant Professor, Department of Zoology, Government first Grade College for Women, Chintamani, Karnataka, India

## Abstract

Pollinators play a vital role in sustaining plant diversity and ensuring food security through cross-pollination. In dry deciduous ecosystems like those in Eastern Karnataka, pollinators are critical to forest regeneration and the productivity of adjacent agricultural zones. This study investigates the species composition, foraging patterns, and ecological roles of insect pollinators in the forests surrounding Chintamani, Karnataka. Systematic transects and pan trap methods were used to survey pollinators across forest edges, interiors, and farmlands. A total of 64 pollinator species were recorded, with bees and butterflies dominating in abundance. Species richness peaked in forest edge habitats, while pollination visitation rates were highest near flowering tree clusters. Anthropogenic pressures such as firewood collection and pesticide drift negatively impacted diversity. The findings emphasize the need for pollinator-friendly forest management practices and highlight native pollinators' significance for both wild flora and nearby crop yields.

**Keywords: Pollination ecology, native bees, butterflies, biodiversity, Karnataka, dry deciduous forest, agroforestry, ecosystem services, floral visitation**

## 1. Introduction

Pollination is an essential ecosystem function, facilitating the sexual reproduction of over 85% of flowering plant species and contributing directly to 35% of global crop production. Among pollinators, **insects—especially bees, butterflies, beetles, and flies—are the most efficient and diverse agents**.

The **dry deciduous forests** of Eastern Karnataka represent a transitional biome between forest and farmland, hosting a unique mix of flora and fauna. However, pollinator studies in this region are sparse, despite its ecological and agricultural significance. With rising anthropogenic disturbances—including pesticide use, habitat fragmentation, and overgrazing—the diversity and abundance of pollinators are under threat.

This study was undertaken to:

- Assess the diversity and composition of insect pollinators across habitat gradients
- Quantify floral visitation patterns
- Evaluate the ecological roles of key pollinators in maintaining biodiversity and supporting agroforestry interfaces

## 2. Materials and Methods

### 2.1 Study Area

The study was conducted in **Chintamani Forest Range** (Kolar-Chikkaballapur district border), located between 13°24′ N to 13°36′ N latitude and 78°04′ E to 78°15′ E longitude. The forest type is **Southern Tropical Dry Deciduous**, dominated by Terminalia, Anogeissus, Albizia, and Cassia species.

Three habitat zones were selected:

- **Forest Interior (FI)** – 1 km inside the canopy
- **Forest Edge (FE)** – transitional zone between forest and farmland
- **Agroforestry Interface (AI)** – adjacent agricultural lands with mixed vegetation

### 2.2 Sampling Period and Techniques

Pollinator surveys were conducted between **January and April 2016** during peak flowering.

**Techniques Used:**

- **Line Transects** (100 m x 2 m): 6 transects per zone, walked twice a week in the morning and afternoon
- **Pan Traps**: UV-colored bowls (blue, yellow, white) placed with soap water to attract flying insects
- **Direct Floral Visitation Observations**: 10-minute watches per plant species

### 2.3 Identification and Classification

Specimens were collected under ethical guidelines and identified using **standard**

**entomological keys** (Michener, 2000; Kehimkar, 2016). Taxonomic confirmation was done with assistance from the Indian Institute of Entomology (IIE), Bengaluru.

Pollinators were classified into:

- **Bees (Apidae, Halictidae, Megachilidae)**
- **Butterflies (Pieridae, Nymphalidae, Lycaenidae)**
- **Hoverflies, beetles, wasps, and ants**

### 2.4 Data Analysis

- Species richness and abundance calculated using **Shannon and Simpson indices**
- One-way ANOVA used to compare zone-wise diversity
- **Pollination Efficiency Index (PEI)** used: Visitation frequency × pollen transfer (from floral surveys)

## 3. Results and Discussion

### 3.1 Species Composition and Diversity

A total of **64 insect pollinator species** were recorded, distributed as follows:

- **Bees** – 27 species (42%)
- **Butterflies** – 18 species (28%)
- **Flies, beetles, and wasps** – 19 species (30%)

Most abundant bee species:

- Apis cerana indica, Tetragonula iridipennis, Xylocopa latipes

Common butterflies:

- Eurema hecabe, Papilio demoleus, Danaus chrysippus

**Forest Edge (FE)** had the highest diversity (Shannon Index = 3.1), followed by Forest Interior (2.7) and Agroforestry Interface (2.4).

### 3.2 Floral Visitation and Pollination Roles

Peak pollinator activity was observed between **08:00–10:30 AM**. Bees were the most efficient pollinators, with an average **PEI of 0.88**, especially on Cassia fistula and Terminalia chebula flowers.

Butterflies and flies served as **supplemental pollinators**, with lower pollen transfer but broader host ranges.

The study confirms that **edge habitats** serve as crucial zones for pollinator activity, likely due to the greater floral resource availability and transitional vegetation.

### 3.3 Threats to Pollinators

Field observations and informal interviews with local farmers indicated:

- **Pesticide drift** from nearby crops negatively impacts wild bees, especially stingless bees.
- **Firewood collection** near forest edges reduces floral host plant density.
- **Lack of nesting sites** for ground-nesting bees due to cattle trampling and soil compaction.

Similar findings have been reported from semi-arid ecosystems in Gujarat and Maharashtra (Chakravorty et al., 2014; Hussain & Kumar, 2015).

### 3.4 Ecosystem Service Value

Native pollinators contribute significantly to **wild plant reproduction** and **nearby crop pollination** (especially legumes and cucurbits). Their role supports **food webs**, soil health, and **seedling regeneration** in degraded areas.

Pollination service valuation, though not quantified here, is estimated to be **over ₹12,000 per hectare annually** in tropical agroforestry zones (Sharma et al., 2013).

## 4. Conclusion

This study reveals that Eastern Karnataka's dry deciduous forests host a diverse and functionally important community of insect pollinators, dominated by native bees and butterflies. Pollinator abundance and species richness are highest at forest edges, which act as transition zones rich in floral diversity and microhabitats.

However, these pollinator populations are under pressure from human activities such as pesticide use, firewood extraction, and grazing. **Conservation of these taxa is not just an ecological imperative but a cornerstone of food security** and sustainable forestry in semi-arid India.

**Recommendations:**

- Establish **pollinator gardens** and protect wild flowering shrubs along forest boundaries.
- Ban or restrict chemical spraying near forest edges.
- Incorporate **bee box-based apiculture** in agroforestry models.
- Launch community-based **pollinator monitoring programs** with tribal and farming groups.

This research strengthens the case for integrating **pollination ecology into forest and agricultural policies** for Karnataka and similar ecoregions across India.

## 5. Acknowledgements

The author gratefully acknowledges the Forest Department of Karnataka, the Indian Institute of Entomology (IIE), Bengaluru, and the faculty of Zoology, Government College for Women, Chintamani, for their support and guidance throughout the fieldwork and analysis.

## 6. Endnotes

1. Bees contribute over 60% of natural pollination in dry deciduous forest plants.
2. UV-colored pan traps are proven effective in capturing a broad spectrum of insect pollinators.
3. Edge habitats often have greater plant diversity and sunlight, attracting more pollinators.
4. Tetragonula iridipennis is a native stingless bee, vital for crop and wild plant pollination.
5. Hoverflies are efficient pollinators of open-access flowers like Corchorus spp.
6. Butterfly visits are generally longer but less efficient in pollen transfer.
7. Forest grazing reduces nesting and foraging opportunities for ground-nesting bees.
8. Declines in pollinators can directly impact food production and seed dispersal.
9. India is home to over 600 species of native bees.
10. Conservation of pollinators aligns with multiple UN Sustainable Development Goals (SDGs).

## 7. References

1. **Potts, S. G., et al. (2010).** Global pollinator declines: trends, impacts and drivers. *Trends in Ecology & Evolution*, 25(6), 345–353. https://doi.org/10.1016/j.tree.2010.01.007
2. **Ollerton, J., et al. (2011).** How many flowering plants are pollinated by animals? *Oikos*, 120(3), 321–326. https://doi.org/10.1111/j.1600-0706.2010.18644.x
3. **Michener, C. D. (2007).** *The Bees of the World* (2nd ed.). Johns Hopkins University Press.
4. **Kehimkar, I. (2015).** *Butterflies of India*. Bombay Natural History Society and BNHS Publications.
5. **Raju, A. J. S. (2011).** Status of pollination ecology studies in India. *Current Science*, 100(2), 185–194. https://www.jstor.org/stable/24071713
6. **Chakravorty, J., et al. (2014).** Traditional knowledge of pollination in agroforestry systems. *Journal of Ethnobiology and Ethnomedicine*, 10, 49. https://doi.org/10.1186/1746-4269-10-49
7. **Klein, A. M., et al. (2007).** Importance of pollinators in changing landscapes for world crops. *Proceedings of the Royal Society B*, 274(1608), 303–313. https://doi.org/10.1098/rspb.2006.3721
8. **Bawa, K. S. (2015).** Forest fragmentation and pollination in the tropics. *Journal of Biosciences*, 41(1), 25–32. https://doi.org/10.1007/s12038-015-9573-1
9. **Bascompte, J., & Jordano, P. (2007).** Plant–animal mutualistic networks: The architecture of biodiversity. *Annual Review of Ecology, Evolution, and Systematics*, 38, 567–593. https://doi.org/10.1146/annurev.ecolsys.38.091206.095818
10. **Sharma, R., et al. (2013).** Economic valuation of pollination services in Indian agroecosystems. *Ecological Economics*, 93, 168–176. https://doi.org/10.1016/j.ecolecon.2013.05.005

11. **Bhattacharya, M., Primack, R. B., & Gerwein, J. (2003).** Are roads and railroads barriers to bumblebee movement in a temperate suburban conservation area? *Biological Conservation*, 109(1), 37–45.
12. **Ali, S., & Ripley, S. D. (2012).** *Handbook of the Birds of India and Pakistan* (Vol. 5). Oxford University Press.
13. **Chandran, M. D. S. (2015).** Pollination and seed dispersal ecology in the Western Ghats. *Current Science*, 108(5), 906–911.
14. **Ricketts, T. H., et al. (2008).** Landscape effects on crop pollination services: are there general patterns? *Ecology Letters*, 11(5), 499–515. https://doi.org/10.1111/j.1461-0248.2008.01157.x
15. **Ghazoul, J. (2005).** Buzziness as usual? Questioning the global pollination crisis. *Trends in Ecology & Evolution*, 20(7), 367–373.
16. **Kumar, H. D., & Singh, N. (2010).** Pollinators and crop yield: A field experiment. *Indian Journal of Ecology*, 37(2), 163–169.
17. **Hussain, A., & Kumar, R. (2015).** Diversity of bees in agro-ecosystems of Karnataka. *Journal of Entomological Research*, 39(2), 123–130.
18. **Basu, P., et al. (2011).** Wild pollinators and their role in crop production: A case study in India. *Apidologie*, 42(6), 712–721. https://doi.org/10.1007/s13592-011-0071-8
19. **Jha, S., & Kremen, C. (2013).** Urban land use limits regional bumble bee gene flow. *Molecular Ecology*, 22(9), 2483–2495.
20. **Sinu, P. A., et al. (2011).** Pollination ecology of *Terminalia* species in dry forests of southern India. *Plant Ecology*, 212(5), 779–790.
21. **Raju, A. J. S., & Ezradanam, V. (2002).** Pollination ecology and fruiting behavior in *Cassia fistula*. *Journal of Plant Research*, 115(3), 183–187.
22. **Barve, V. V., et al. (2015).** Diversity of bees in a tropical dry deciduous forest: a pilot study. *Journal of Threatened Taxa*, 7(4), 7101–7105. https://doi.org/10.11609/JoTT.o3967.7101-5
23. **Kevan, P. G., & Viana, B. F. (2003).** The global decline of pollination services. *Annals of Botany*, 91(3), 367–383. https://doi.org/10.1093/aob/mcg035
24. **Winfree, R., et al. (2007).** Native bees provide insurance against ongoing honey bee losses. *Ecology Letters*, 10(11), 1105–1113.
25. **MoEFCC (2014).** *India's Fifth National Report to the Convention on Biological Diversity*. Ministry of Environment, Forest and Climate Change. https://www.cbd.int/doc/world/in/in-nr-05-en.pdf