

# Biodiversity: A Function of Plant-Animal Interactions in the Eastern Ghats Forest Ecosystem

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**Abstract**----Biodiversity is a function of web of interactions taking place between plants and animals. The interactions between them are very complex, intricate and function in association with the abiotic environment. Since biodiversity is the key for the structural and functional integrity of ecosystems and it is the foundation for the very survival and sustainability of life on this planet, it is imperative to understand the interactions and interrelationships that exist between plants and animals. Without field studies, it is impossible to understand and frame effective conservation and management measures for the sustainability of biodiversity. Tropical latitudes in general and India in particular are rich in biodiversity and formed the basis for the origin and development of various societies and civilizations. It is in this context, I intend to explain the relationships, one-sided or mutual, that exist between different plants and different categories of insects, birds and others in flowering plants of terrestrial and mangrove ecosystems, and also in gymnosperm species such as *Cycas*. Further, the talk would also focus on how bee-flower interactions, bird-flower interactions, and plant-animal interactions, all collectively contribute to the structural and functional integrity of ecosystems or habitats or forests.

**Keywords**---plants, bees, birds, biodiversity

## I. INTRODUCTION

**B**EES, birds and others visit flowers for sustenance. They are recognized as the most important pollinators in almost all ecosystems where flowers occur. Their precise roles in pollination are not well documented. Some plants utilize a wide array of insects, birds and bats alternatively for achieving pollination. Some other plants have specializations in floral structure for achieving pollination by specialized pollinators. Further, some relationships between plants and animals are highly specific that a single animal species is responsible for the pollination of a particular plant species. The restriction in the number of pollinator species of a plant species in such a situation increases the chance of successful pollen transfer. The specific pollinators are assured of a meal from that plant which they alone can feed. But, if one side of the relationship breaks down, to say, by the non-availability of pollinators, the other side (the plant) is doomed if the latter lacks the alternative systems of reproduction.

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Plant-animal interactions are very vital for sustaining biodiversity. Bees use pollen as a protein source and nectar as an energy source. Birds use flowers as nectar source as well as insect source. Different bees have different pollinating abilities depending on the floral density and characteristics such as size, shape, colour, scent, access to floral rewards, quality of pollen and nectar, etc.

Bees and birds require food throughout the year. This necessitates the availability of floral sources throughout the year. For this, different plants should bloom at different times so that bees get food year-long. Perennial plants play a vital role in sustaining bees while annuals and short-lived plants which usually appear during rainy season provide additional amount of food. As different flowers have different floral configurations with varying amounts of floral rewards, bees should use different handling behaviours to harvest them. It is in this context, the flowers, bees and birds have developed and evolved certain characteristics over a period of time for their mutualistic dependence. This has contributed to the richness and perpetuation of biodiversity [1].

## II. HONEY BEES

Honey bees are the most valuable pollinators for agricultural and natural plants. They have several positive characteristics such as foraging behaviour, foraging rate, foraging range, flower constancy and colony strength which make them as general pollinators [2-4]. The honey bees have become the primary source of pollination in agricultural ecosystems in almost all countries. Further, they have taken over as pollinators of many of the wild plants because many species of wild pollinator populations have declined due to the destruction of habitats. The flower-feeding activity of honey bees have been found to have an important role in sustaining and multiplying a number of flowering species; in effect resulting in the enrichment of biodiversity [1].

## III. DIGGER BEES

*Amegilla* bees are robust, fast-flying, ground nesting with velvety fur. They collect both pollen and nectar from wild and crop flowers available in their habitats. Their floral sources include mostly the members of Verbenaceae, Lamiaceae, Solanaceae, Acanthaceae and Fabaceae [5].

## IV. CARPENTER BEES

Carpenter bees construct nests in rotting decayed wood, the pithy or hollow stems of plants. They are solitary, appear in

black and yellow, and robust like bumble bees. The fertilized female carpenter bees make nests by digging tunnels with various plant species. They visit flowers which are specialized in floral form and offer nectar and pollen according to their requirements and to their senses in some respect. The floral characteristics of carpenter bee flowers, in principle, include spacious, having parts strong enough to withstand abrasion by rough foot work of insects, containing hidden nectar, mostly accessible only by force, corollas with strong walls and other protecting devices that prevent nectar robbing, with sex organs touching the backs of the visitor, having pale and saturated colours, with a fresh odour, ephemeral day-blooming, and having sparse nectar with high sugar concentration. The flowers with these characters are exclusively adapted to foraging by carpenter bees. They use medium to large-sized tubular or non-tubular flowers for collecting their food [2,6]. They use buzzing foraging behaviour to collect pollen from poricidally dehiscent anthers [6].

The importance of carpenter bees in the sexual reproduction of different wild or cultivated plant species is well known. The bees are very important for higher yields in vegetables and certain legume crops. Agricultural practices are posing threats to the nesting materials and food sources of bees in agro-ecosystems. This unfortunate situation can be avoided if some wild patches are kept undisturbed in agricultural systems to provide both nesting and food sources to these bees.

#### V. BIRDS

Passerine and non-passerine birds use mostly summer blooming plant species in the Eastern Ghats as nectar sources. The flowers of these plants serve also as insect sources which form protein-rich diet for them. The plant species used by birds in the Eastern Ghats include *Careya arborea*, *Gmelina arborea*, *Anisomeles malabarica*, *A. indica*, *Leonotis nepetaefolia*, *Acanthus ilicifolius*, *Spathodea campanulata*, *Butea monosperma*, *Butea superba*, *Bombax ceiba*, *Erythrina suberosa*, *E. varietaga*, *Firmiana colorata*, *Woodfordia floribunda*, *Dendrophthoe falcata* and *Helicteres isora*. Of these plants, *Anisomeles* produce purple-flowers, *Careya* cream-coloured flowers, *Gmelina* yellow flowers, *Acanthus* bluish-purple flowers while all plants produce either scarlet red or red flowers. The birds such as sunbirds, bulbuls, white-eyes, babblers, mynas, drongos, flower-peckers, parakeets, etc. visit the flowers regularly, especially during early morning hours when floral nectar is fresh and available for use without any difficulty. The birds contribute to pollination in these plants while collecting nectar. Such a relationship between birds and plants is mutualistic and results in the functioning of biodiversity.

#### VI. DISCUSSION

The value of bees in the pollination of crops and wild plants is incalculable. The role of bees in pollination in agro-ecosystems for increasing the crop yields, both quantitatively and qualitatively has been documented by many. Unfortunately, the increasing monoculture practices, intensification of cropping systems, growing use of agrochemicals and rapid deterioration of natural areas are

collectively contributing to a gradual decline in pollinator bee populations. There is a growing evidence of localized declines of pollinators due to symptomatic results of wide scale losses of biological diversity. Pollinator declines limit seed and fruit production and disrupt food supplies. Heavy reliance on a broad spectrum of pesticides by agriculturists poses a major threat to pollinators. Over and erroneous usage of pesticides greatly influences the actual coverage area of applied pesticides, jeopardizing pollinator inhabiting areas. Pollinators, especially honey bees often are killed in large numbers by insecticides. They also accumulate other pesticides in their bodies and hives. Herbicides affect indirectly through the loss of forage and wild flowers important for maintaining some bee populations. As the pesticides are lethal to pollinators, the buffer strips in agro-ecosystems act as critical habitats for pollinators and serve as protective covers from pesticide over-sprays. Habitat manipulation associated with agriculture adversely affects availability of both food and nesting sites for pollinators. All this indicates that the historical assumption that pollination is a free ecological service is quite erroneous. Therefore, a rational assessment and valuation of pollinator resources has become a major concern in agro-ecology as scarcities of these resources are gradually increasing and this underlines the need to conserve and manage wild habitats for sustaining pollinator diversity.

The flowers visited by birds are usually red in colour [7] and exhibit certain characters such as tubular corolla to contain nectar, absence of floral odour, hard floral parts, filaments stiff or united, the curved petals or lobes which wither soon after flower-opening, etc. [8-10]. In most of the plant species mentioned above to which birds pay visits fulfill these criteria and suggest ornithophily. Certain species such as *Anisomeles*, *Acanthus*, *Gmelina*, *Careya* plants are primary entomophilous but also use birds as pollinators. These relationships suggest that biodiversity is the joint venture of plants and animals in general and in this case between plants and birds. Therefore, it is high time for us to understand this and take measures for the effective conservation and management of biodiversity by involving naturalists, academicians and non-governmental organizations.

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