POLLINATOR DIVERSITY IN DRY SEASON BLOOMING ORNITHOPHILOUS TREE SPECIES IN YAVATMAL DISTRICT MAHARASHTRA

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Abstract
The present study documents the role of avian pollinators in the reproductive ecology of selected dry season blooming angiospermic tree species in Yavatmal district, Maharashtra. Field observations were conducted on Bombax ceiba, Butea monosperma, Erythrina variegata, Syzigium cumini and Spathodea campanulata to assess flowering phenology, floral biology and associated bird pollinators. A total of 12 bird pollinators species, showing differential visitation rates and foraging behavior across tree species. The flowering phenology revealed these tree serve critical nectar resources during the dry season, bridging floral scarcity and supporting local avian diversity. Detailed observations on floral morphology, nectar production and pollination syndromes indicated adaptations for ornithophily particularly in Bombax, Butea, and Erythrina while Syzigium and Spathodea also attracted generalist nectarfeeding birds. The findings highlight the ecological importance of dry season bloomers in maintaining biodiversity in semi arid landscapes. The study contributes to the understanding of plant pollinator networks in central India and underscores need for conservation of keynote tree species that support avifaunal communities.
Keywords: *Ornithophily, Bird Pollinators, Flowering Phenology, Ornithophilous Trees.*

Introduction

Pollination is an essential ecological process, ensuring the reproductive success of angiosperms and maintaining ecosystem stability. Among the various pollination syndromes, ornithophily (pollination by birds) is particularly intriguing due to its specialization of both plants and pollinators. Ornithophilous plants often display brightly colored, unscented flowers with tubular corollas and copious sucrose-rich nectar, attracting avian visitors especially during periods when insect activity is low, such as the dry season.(Faria R. R. et al 2010; Shuvam Sengupta et al. 2021)

Dry season blooming among ornithophilous tree species is a notable strategy, as it coincides with reduced rainfall, lower humidity, and generally diminished floral resources in most ecosystems. This phenology offers multiple ecological advantages: increased visibility of flowers due to leaf drop, reduced competition for pollinators, and minimized rain-induced damage to flowers. (Raju A.J.S. et al. 2012)

The Yavatmal district in Maharashtra, India, hosts deciduous forest ecosystems with a diversity of bird-pollinated tree species. Dry season blooms are key to sustaining pollinator populations when resources are scarce, providing nectar and pollen to avian pollinators such as sunbirds, flowerpeckers, and occasionally hummingbirds. However, reproductive ecology of such tree species, the diversity, abundance, and community structure of pollinators visiting these ornithophilous trees during the dry season have remained largely undocumented in Western Vidarbha region particularly in Yavatmal district.

The objectives of present investigation was to assess the diversity of pollinators visiting dry season blooming ornithophilous tree species in Yavatmal district, Characterize the phenology, floral biology, and resource availability of key tree species, Examine interactions between birds and flowers, Discuss ecological implications and conservation challenges in the context of dry season flowering.

Materials and Methods

Study Area

The research was conducted across several forest fragments, village groves, and farm hedge habitats of Yavatmal district from January 2023 to May 2023 in dry season. The climate is tropical with pronounced wet and dry seasons, and the vegetation consists primarily of dry deciduous trees. Key ornithophilous tree species selected for this study flower predominantly from January to May, encompassing the local dry season.

Selection of Ornithophilous Tree Species

Preliminary botanical surveys identified several native and naturalized tree species with ornithophilous traits, their flowering phenology and floral biology.

1. *Bombax ceiba* (Red Silk-cotton Tree) Family- Bombacaceae

2. *Erythrina Variegata* (Indian Coral Tree) Family- Papilionaceae
3. *Butea monosperma* (Flame of the Forest) Family- Papilionaceae
4. *Syzygium cumini* (Jamun) Family- Myrtaceae
5. *Spathodea campanulata* (African tulip tree) Family- Bignoniaceae

Pollinator Sampling and Observation

Fieldwork was carried out using a combination of focal observations, timed watches, binoculars and Nikon DSLR Camera recordings during peak flowering days. Observations spanned dawn to late morning when pollinator activity is highest. Each flowering tree was observed for:

1. **Frequency of bird visits**: The bird pollinators visits were observed at day time in morning, afternoon and evening on some tagged inflorescences visually and with binoculars, Photographs were taken at site. Flower visitors were also noted at changing blooming conditions like in early flowering, peak flowering and maturity phases.
2. **Identification of pollinator species** (visual and acoustic identification): The observed visitors has been identified on site and some from photographs and recordings by bird experts.

Supplementary insect pollinators (e.g., bees, butterflies) were recorded opportunistically for completeness.

Results and Discussion

Flowering Phenology and Floral Biology

Most selected tree species exhibit an extended, synchronous flowering phase during the dry season. *Bombax ceiba* flowers are large, thick, crimson coloured and fascicled at the end of branches. Each flower has short stalk with usually three lobed fleshy cup shaped sepals, corolla with very showy crimson coloured 5 petals with closed parallel veins, stamens numerous, almost as long as petals, anthers lobes twisted and arranged in 5 bundles on opposite to each petal and central bundle of 15 stamens around style, stigma with 5 lobes and 5 celled ovary.

Flowering in *Butea monosperma* occurs from February to March. The flowers are large, in dense fascicles at the end of leafless branches. The flower stalk is velvety dark green and each flower consist of cup shaped calyx having 5 sepals which are olive green with fine shiny hairs, corolla with 5 petals, bright, orange red coloured with fine hairs, stamens are ten diadelphous.

In *Erythrina variegata* flowering occurs from February to April. Flowers are numerous, large, red or bright scarlet, showy in dense clustered racemes at end of branches with large nectar, calyx with 5 sepals forming a sheath around corolla with 5 petals. The standard is much larger but clawed at base, partial covering the two wings and fused keel, stamens are 10 diadelphous 9 stames united and one is free, ovary monocarpellary.

Flowering in *Syzigium cumini* occurs from March to April. The flowers are greenish white, small fragrant and are borne in trichotomous panicles arising from twigs usually below the leaves. Each flower consist of 5 sepals fused to form calyx tube, 5 petals jointed to form cup or calyptra which fall off in one piece exposing numerous white stamens and bicarpellary syncarpous inferior ovary.

In *Spathodea campanulata* flowering occurs from February to April. The flower buds are enclosed in sickle shaped calyx open on one side and curves backwards, exposing corollas which are tulip like, consisting of short narrow tube expanding into 5 lobed, bell shaped structure which is orange and crimson outside and yellow straked with red inside, stamens 4, yellow with brown anther, style is stout, longer than corolla.

Ornithophilous Traits in Selected Tree Species

The dry season blooming tree species studied exhibit distinct ornithophilous characters that facilitate bird-mediated pollination. *Bombax ceiba* produces large, bright red flowers borne on leafless branches, making them highly conspicuous during the dry season. The flowers are fleshy and open during the day, secreting copious dilute nectar and possessing strong floral parts that can withstand repeated bird visits, while their exserted stamens and stigma ensure effective pollen transfer. Similarly, *Butea monosperma* bears dense clusters of orange-crimson blossoms on leafless branches, with striking pigmentation and little fragrance,relying primarily on visual attraction. Nectar is produced in the keel region, accessible to sunbirds, mynas, and parrots, and the sturdy flower stalks allow perching and effective foraging. *Erythrina variegata* displays scarlet red, tubular flowers arranged in terminal racemes that open sequentially, thereby ensuring prolonged nectar availability. These flowers, lacking fragrance but rich in nectar, are adapted for birds with strong beaks, and their orientation favors contact between visiting birds and reproductive organs. In *Syzygium cumini*, the creamy-white flowers with numerous exserted stamens produce nectar at the base of the flower, attracting both insects and generalist birds such as parakeets and bulbuls. Though less specialized, its mass-flowering pattern offers abundant nectar resources during the dry season,

and the inflorescences are strong enough to support bird activity. *Spathodea campanulata* produces large, bell-shaped orange-scarlet flowers in terminal clusters, secreting copious watery nectar, sometimes to the point of overflow. The lack of fragrance is compensated by bright coloration and visual display, while the strong calyx and corolla provide a perch for visiting birds, and the orientation of flowers ensures contact with stamens and stigma during feeding. Collectively, these species exhibit the classic traits of ornithophily, including bright red to orange floral coloration, diurnal anthesis, production of dilute nectar, strong floral structures for perching, and exserted reproductive parts, all of which highlight their ecological significance as critical nectar resources for avian pollinators during the resource-scarce dry season.

Pollinator Diversity

Avian Pollinators

Focal observations and remote recordings identified 12 bird species as regular visitors:

Table 1: Record of the avian pollinators on the flowers of selected tree species

Sr. No.	Bird Species	Common Name	Family	*Bombax*	*Butea*	*Erythrina*	*Syzigium*	*Spathodea*
1	*Psittacula krameri*	Roseringed parakeet	Psittacidae	+	+	+	+	+
2	*Megalaima haemocephala*	Coppersmith	Capitonidae	+	-	-	-	-
3	*Dicrurus adsimilis*	Black Drogo	Dicruridae	+	+	+	+	+
4	*Acridotheres ginginianus*	Black Myna	Sturnidae	+	-	-	-	-
5	*A.tristis*	Indian Myna	Sturnidae	+	+	+	-	+
6	*Pycnonotus jocosus*	Redwhiskered Bulbul	Pycnonotidae	+	+	-	-	-
7	*Turdoides caudatus*	Common Babbler	Muscicapidae	+	+	+	-	-
8	*Dicaeum erythrorhynchos*	Tickell's flowerpecker	Dicaeidae	-	-	-	+	-
9	*Dicaeum pallidum*	Pale billed flowerpecker	Dicaeida	+	-	-	+	-
10	*Nectarinia zeylonica*	Purplerumped Sunbird	Nectarnidae	-	-	+	-	-
11	*N. asiatica*	Purple Sunbird	Nectarnidae	+	+	+	-	-
12	*Oriolus oriolus*	Indian Golden Oriole	Oriolidae	-	+	+	-	-

Purple Sunbirds and flowerpeckers were the most frequent visitors, accounting for more than 64% of total bird visits across sampled trees. Purple Sunbirds tended to visit in short, energetic bursts, often circling the entire canopy, while flowerpeckers showed systematic traversal of inflorescences, optimizing pollen transfer. (Raju A.J.S. et al. 2012)

Insect Pollinators

Although not primary pollinators, several bee and butterfly species were documented: Carpenter bees (*Xylocopa* spp.), Honey bees (*Apis dorsata, A. cerana*) , Pierid and Nymphalid butterflies

Insect visitation rates, however, were substantially lower in ornithophilous trees compared to adjacent insect-pollinated species, underscoring floral specificity in pollinator attraction. (Dr. Muniraju 2016).

There is abundant pollinator diversity in forest edge habitats and open groves where floral displays were most visible. Diversity and abundance of pollinators visiting dry season blooming ornithophilous trees in Yavatmal are shaped by Flower visibility due to leaf fall, Dry season scarcity of floral resources focuses pollinator attention on blooming trees, intensifying visitation and cross-pollination. Edge habitats and fragmented forest patches promote higher pollinator diversity

due to the mosaic offering diverse foraging and nesting sites. Habitat degradation, firewood collection, and pesticide use can negatively impact pollinator populations, as observed in similar dry deciduous ecosystems across India.

Ornithophilous trees in Yavatmal demonstrate co-adaptive traits such as sturdy floral architecture, prolific nectar supply during dry periods, and extended anthesis to accommodate daily bird foraging routines. Birds, in turn, rely on these flowers for energy, particularly when insects are less abundant. Avian species are co adapted for ornithophily having long curved beak, long tongue, small size and hovering ability.

Sustaining pollinator diversity during the dry season is crucial for forest regeneration, gene flow, and ecosystem resilience. Ornithophilous tree species serve as keystone resources, supporting not only birds but also maintenance of complementary insect pollinator communities.

Conclusion

Dry season blooming ornithophilous tree species in Yavatmal district host diverse pollinator assemblages, predominantly birds but also including complementary insects. Their phenological strategy ensures resource continuity for pollinators when alternatives are scarce, underpinning ecological stability and forest regeneration. Conservation efforts targeting pollinator habitats, minimizing pesticides, and protecting forest edges are vital for sustaining these intricate plant-pollinator networks.

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