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Pollination and seed dispersal by animals in the dry deciduous forests of southern Eastern Ghats

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(Collaborative Research Project funded by the Tamil Nadu Forest Department-Research Wing)

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SUMMARY

Animal pollinator of flowers or disperser of seeds is termed as “mutualist” (Kelly *et al* 2006). The two major “mutualistic interactions”, Pollination and Seed dispersal are important events in the life of plants. While the pollinators aid in cross pollination, the seed dispersers assist in the dissemination of diaspores to far away locations and suitable micro sites required for seed germination. In this mutualistic relationship, the reward to animals is food, in the form of pulp or nectar and for the plants it is the benefit of cross pollination or seed dissemination. Potential pollinators include animal species belonging to the class Insecta (Bees, Butterflies, Wasps, and Thrips etc), Aves (birds) and mammalia (bats, civets). The failure of mutualisms may accelerate the erosion of biodiversity in disturbed and fragmented forests. Plants that depend on the services of animals are expected to be in great danger, because the vulnerabilities of the mutualists are added to the plant itself. Flower dependent animals may be equally vulnerable to changes in flower supply resulting from deforestation, logging and influence of climatic change on plant phenology. Information on pollination and seed dispersal are very essential for the better management of forests. Hence, the present study was undertaken in the dry deciduous forests of southern Eastern Ghats.

The present study was aimed to document the pollinators and seed dispersers of woody plants in the dry deciduous forests of five hill ranges namely, i. Dhimbam Ghats (Sathyamangalam Forest Division), ii. Andhiyur (Erode Division), iii. Kolli hills (Namakkal Division), iv. Shervaroy hills (Salem Division) and v. Javadi hills (Vellore Division) in Tamil Nadu Eastern Ghats.

Although five study locations were identified, it was resolved to make a detailed investigation in Dhimbam Ghats, Hasanur forests, Sathyamangalam Forest Division during the first year and conduct a rapid vegetation inventory



in other four hill stations in the second year. The project was initiated in March 2007 and completed in March 2009. Detailed investigation included the study on phenology of woody species, documentation of probable pollinators, seed dispersers and quantification of vegetation in the dry deciduous forests.

To assess the flowering and fruiting season of plants, phenological studies are very essential. Hence, phenological studies on the fleshy fruit-bearing and nectar yielding plants were carried out. A total of 400 individuals belonging to 40 woody species were tagged and observed for phenology. Tagged plants were monitored fortnightly, for recording the flowering and fruiting activity. During the observation, percent of flowering and fruiting activity in the canopy were noted for each tagged individual. To quantify the vegetation, quadrat method was used. Vegetation quantification was done in two types of habitats, namely undisturbed dry deciduous forest and degraded forest. The criteria followed for deciding sites sampling was subjective and from the signs such as lopping, cattle grazing, nearness to human habitation and collection of non-timber forest produces. Vegetation sampling was done by laying 1 ha. plot. In the remaining three hill areas, undisturbed forest site alone was sampled for vegetation analysis. The 1 ha. plot was subdivided in to 100 sub plots (10 x 10 m). The GBH of plants occurring in the 10 x 10 m plot was recorded. Plants that measured >20 cm GBH (Girth at Breast Height) were considered as woody species. Number of shrubs and saplings occurring in the 10 x 10 m plots were counted. Five 1 x 1 m plots were laid within the 10 m² quadrat to record seedlings. The data was analysed to obtain quantitative values such as density, abundance, frequency etc.

To document the insect pollinators, direct observations were carried out on the inflorescences of select trees, using a pair of binoculars as well as by



using a hand held lens. Extended watches, 6 am to 6 pm were carried out at the focal flowering tree. For each tree, 24 hours observation was made to record the flower visitors. Of the 24 hours, 12 hours were spent to record the frequency of visitors, and 12 hrs to record the foraging behaviour of insect visitors. Avian frugivores and pollinators were documented by recording the activities of birds foraging on fleshy fruits or flower nectar. Two methods were used; in the first method, birds foraging on fruits or nectar were recorded while walking along the transects. Observation was carried out between 06:00 am to 10:00 am and 3:00 pm to 6:00 pm since it is the peak foraging time for birds. In the second method, extended watches were carried out in focal fruit and nectar yielding trees to record the frugivore and pollinator visitation.

Phenological observations indicate the occurrence of seasonality. The number of species in flowers attained a peak (n=26) during the summer and a dip in north-east monsoon (n=6). Maximum number of woody species (32 species) had fruits during the south-west monsoon and a dip was noticed during post monsoon (12 species).

The results of vegetation analysis revealed the occurrence of 317 individuals belonging to 30 species in the undisturbed site. Highest Importance Value Index values were recorded for *Ficus benghalensis* (46.55) followed by *Bambusa arundinacea* (39.30) and *Erythroxylum monogynum* (34.94). In the degraded site, 14 tree species (56 individuals) were recorded. Maximum Importance Value Index values were recorded for *Ficus benghalensis* (79.57) followed by *Canthium dicoccum* (55.79) and *Capparis grandis* (45.61).

In the dry deciduous forests of Sathyamangalam Forest Division, 25 plant species belonging to 16 families were observed for 600 hrs. A total of 80



species of insects were recorded during the study period. Only 55 species could be identified. Important insect visitors included Lepidoptera (butterflies and moths) 32 species, followed by Hymenoptera (bees, wasps and ants) 23 species, and others. Highest number of insect species were attracted by *Ligustrum perrottetii* (n=32) followed by *Zizyphus rugosa* (n=30), and *Zizyphus mauritiana* (n=27).

Besides these, a comparative study of insect visitors in the disturbed and undisturbed forest habitats was done for four plant species viz., *Santalum album*, *Gmelina arborea*, *Canthium dicoccum* and *Tarenna asiatica*. Trees in the undisturbed site attracted higher number of insect visitors than the disturbed forest site.

A total of 49 butterfly species used floral nectar as food. Of the 21 plant species visited by butterflies, highest number was recorded in *Lantana camara* (27), followed by *Canthium dicoccum* (13), and *Ligustrum perrottetii* (11). Regarding the frequency of flower visitation by butterflies, the Pioneer (14.79%) contributed maximum number of visits followed by Lemon Pansy (8.54%) and Banded Awl (8.13%). Majority of the butterfly visited flower species in the study area had white flowers (57.14%), followed by red (19.04%), green (14.28%) and yellow (9.52%). However, maximum number of butterfly species was attracted to red flowers (n=36). With regard to the size of butterfly visited flowers, small sized (<1cm) flowers attracted higher number of species (n=48) followed by medium sized (n=18), and large sized flowers (n=5). Observations on Honey bee-tree interactions revealed that, in the dry deciduous forests of Sathyamangalam Forest Division, a total of 22 plant species were visited by honey bees. Four species of honey bees *Apis dorsata*, *A. indica*, *A. florea* and *Trigona irideppennis* were recorded. *Apis indica* visited maximum number of plant species. *Pongamia pinnata*,



Terminalia bellirica, *Tamarindus indica* attracted all the four honey bee species and appear to be very important for sustaining the honey bee population here.

To document the avian pollinators extended observations were carried out on 6 nectar yielding tree species namely, *Bombax malabaricum*, *Butea monosperma*, *Chukrasia tabularis*, *Gmelina arborea*, *Mimusops elengi* and *Syzygium cumini*. A total of 27 species of bird species visited these plants. Majority of the nectar feeding visits were made by Purple-rumped Sunbird (18.15%), followed by Purple Sunbird (17.18%), and Oriental White-eye (11.10%). These birds appear to play a major role in the pollination of their food plants. During the transect walks, 34 species of nectarivorous birds were recorded on 36 plant species. Majority of the nectar feeding visits were made by Sunbirds. Purple rumped Sunbird (35.63%), followed by Purple Sunbird (22.38%) and Loten's Sunbird (7.34%).

To document frugivory by birds, extended feeding watches were carried out on 11 fleshy-fruited plant species for a period of 244 hours. A total of 22 fruit-eating birds visited these plant species. Two species, *Psittacula krameri*, *P. columboides* were considered as seed predators as they mainly consumed the seeds. Remaining species ate the fruits wholly or partly and regurgitated/defecated the seeds and hence considered as seed dispersers. *Ficus benghalensis* attracted maximum number of bird species (20) followed by *Ficus infectoria* and *Ficus microcarpa*.

During the transect walk observations 37 species of fruit-eating birds were recorded. Bulbuls (44%), Barbets (17%), Mynas (16%), Pompadour green Pigeon (11%) and Indian Grey Hornbill (7%) were found to be the major frugivores. These species appear to play an important role in seed dispersal.



Among the 50 plant species, *Lantana camara* attracted maximum number of bird species (n=25) followed by *Fluggea leucopyrus* (n=21), *Ficus benghalensis* (n=20), *Ficus drupacea* (n=20), *Vitex altissima* (n=19), *Ficus infectoria* (n=18) and *Ficus microcarpa* (n=17).

During the transect walk observations, 34 species of nectar feeding birds were recorded on 36 plant species. *Eucalyptus tereticornis* attracted highest number of bird species (n=25) followed by *Butea monosperma* (20), *Bombax malabaricum* (19), *Gmelina arborea* (15), *Mimusops elengi* (8) and *Syzygium cumini* (8).

To assess the dispersal of seeds by mammals scat analysis was done. Scats/faeces/dungs of four mammals, namely Sloth Bear, Short-nosed Fruit Bat, Asian Elephant and Bonnet Macaque were collected and analyzed. Seeds of 29 plant species were identified. Bonnet Macaque followed by Sloth Bear dispersed largest number of species. Based on the present study, 30 indigenous woody species are recommended for planting in the degraded dry deciduous forest tract of Sathyamangalam Forest Division. The woody plant species suggested here are grouped under two major categories namely, fleshy-fruit yielding plants and nectar-yielding plants. The fleshy fruits are expected to attract fruit-eating birds and nectar-yielding species would attract nectarivorous birds and insect pollinators.

In Andhiyur hills, vegetation sampling was done in two forest sites viz. undisturbed and disturbed dry deciduous forests near Varattupallam. The results revealed the occurrence of 58 tree species in the undisturbed forest site. Maximum Importance Value Index values were recorded for *Pleiospermium alatum* (35.75) followed by *Azadirachta indica* (22.75) and *Prosopis juliflora* (21.33). In the disturbed site, maximum Importance Value



Index values were recorded for *Chloroxylon swietenia* (60.21) followed by *Pleiospermium alatum* (51.43) and *Canthium dicoccum* (32.06).

Insect pollinators were recorded for 13 plant species. 34 insect pollinator species were identified. 10 species could not be identified. Hymenoptera (Bees and wasps) (58%) formed the most dominant pollinator group. *Tectona grandis* (n=21) followed by *Erythroxylum monogynum* (n=15) attracted maximum number of insect pollinators.

To document the avian frugivores in Andhiyur, extended observations were made on 11 fleshy-fruited species. A total of 22 species of frugivorous birds were recorded. Majority of the fruit feeding visits were made by bulbuls. White-browed bulbul (24.82%), Red-vented bulbul (20.22%), Red-whiskered bulbul (11.21%) and Brown-headed Barabet (9.87%) formed the major frugivores and seed dispersers.

In Kolli hills, vegetation sampling was done in an undisturbed forest site (1 ha.) at an altitude of 520 m above msl at the 11th bend of the highways. The results of vegetation assessment revealed the occurrence of 1370 trees belonging to 77 tree species under 68 genera spreading over 32 families. Shannon's Species diversity index for tree community was worked out to be 3.95. Maximum Importance Value Index values were recorded for *Gyrocarpus americanus* (22.65) followed by *Albizia amara* (16.94) and *Garuga pinnata* (13.77). The results of analysis of shrub species showed that the occurrence of 12483 individuals belonging to 107 shrub species under 94 genera spreading over 37 families. Of the 107 species recorded, 63 species formed tree saplings and the remaining 44 species were shrubs. The results of seedling analysis showed that the occurrence of 3402 seedlings belonging to 93 species under 80 genera spreading over 38 families. Of the 93 seedling



species reported 42 species are bird-dispersed species. Although many of the bird-dispersed trees showed good regeneration, species such as *Azadirachta indica*, *Crateva roxburghii*, *Capparis grandis*, *Ehretia ovalifolia*, *Grewia tillifolia*, *Vitex altissima* and *Zizyphus mauritiana* showed poor regeneration. A total of 34 woody species are suggested for planting in the degraded dry deciduous forests of Kolli hills.

In shervaroy hills, vegetation analysis was carried out at an altitude of 400 m above msl at Vinayagampatti. A total of 1714 trees belonging to 91 species under 75 genera spreading over 37 families were recorded. Among the 91 tree species, *Glochidion zeylanicum* was represented by maximum number of individuals (158) followed by *Acacia chundra* (134) and *Semecarpus anacardium* (117). Of the 36 families recorded here, Euphorbiaceae formed the dominant family with 8 tree species followed by Mimosaceae (6 species) and Caesalpiniaceae, Rubiaceae, Rutaceae and Moraceae (5 species each). Shannon's diversity index for the tree flora worked out to be 3.79. The shrub flora analysis indicated the occurrence of 15465 individuals belonging to 114 species under 96 genera spreading over 33 families. Of the 114 species recorded, 63 species formed tree saplings and the remaining 51 species were shrubs. A total of 4568 seedlings belonging to 84 species under 73 genera spreading over 41 families were recorded. Of the 84 seedling species recorded here, 38 species are dispersed by birds. Among the 38 bird-dispersed species, four species, *Alangium salviifolium*, *Ehretia ovalifolia*, *Premna tomentosa* and *Zizyphus mauritiana* showed poor regeneration. A total of 32 woody species are suggested for planting in the degraded dry forest tracts of Shervaroy hills.

In Javadi hills, the vegetation data was collected from an undisturbed forest site in Jamunamarathur. A total of 1020 trees belonging to 65 species under 50 genera spreading over 28 families were recorded. Among the 65 species



of trees, *Strychnos nux-vomica* was represented by maximum number of individuals (56) followed by *Premna tomentosa* (38), *Anogeissus latifolia* and *Chloroxylon swietenia* 34 each. Of the 33 families recorded here, Moraceae formed the most dominant family with 7 species followed by Euphorbiaceae (6 species) and Rutaceae (5 species). Maximum Importance Value Index values were recorded for *Ficus benghalensis* (77.57) followed by *Strychnos nux-vomica* (23.01) and *Premna tomentosa* (10.87). Shannon's species diversity for tree flora worked out to be 3.25. The shrub flora analysis revealed the occurrence of 11904 individuals belonging to 81 species under 78 genera spreading over 36 families. Of the 81 species recorded, 45 species formed saplings of trees and the remaining 36 species were shrubs.

A total of 3504 seedlings belonging to 70 species under 67 genera spreading over 33 families were recorded. Among the 70 species of seedlings, *Lantana camara* was represented by maximum number of individuals (513) followed by *Tarenna asiatica* (489), *Cipadessa baccifera* (361) and *Carmona retusa* (218). Of the 70 seedling species recorded, 37 were bird-dispersed species. Among the 37 bird-dispersed species, species such as *Azadirachta indica*, *Canthium dicoccum*, *Diospyros montana*, *Drypetes roxburghii*, *Ixora arborea*, *Vitex altissima* and *Zizyphus mauritiana* showed poor regeneration. A total of 30 woody species are suggested for planting in the dry forest tracts of Javadi hills.