ROLE OF FRUGIVOROUS BIRDS IN SEED DISPERSAL IN THE MIXED DRY DECIDUOUS FORESTS OF ATTAPPADY AND ANAIKATTY, WESTERN GHATS

R. ARUNA, P. BALASUBRAMANIAN AND P. RADHAKRISHNAN*

Salim Ali Centre for Ornithology and Natural History, Coimbatore (Tamil Nadu).

Introduction

Fleshy fruits, which are apparently adapted for consumption by vertebrate seed-dispersers are very common in most tropical forests (Willson *et al*., 1989). The survival of a plant species is best ensured by the dispersal of fruits and seeds to as many different and far off localities as possible (Venkateswaralu, 1982). Among the regular methods of seed dispersal, birds play a vital role, because of their fruit eating habits and the long distances they travel (Ridley, 1936). It is generally regarded that seeds defecated by birds germinate much faster than the normal seeds. A variety of birds and mammals depend predominantly on fruits to fulfill their nutritional requirements. Frugivorous animals also help seeds to escape from the deleterious effects of seed and seedling predators (Janzen, 1970). Due to the fact that forest birds are generally more abundant than mammals, birds are expected to move large quantities of seeds from the parent plants.

The study of relationships between bird-dispersed plants and fruit-eating birds in the tropical region has received considerable attention (Howe and Estabrook, 1977; Frost, 1980; Beehler, 1983; Wheelwright *et al.*, 1984; Gautier-Hion *et al.,* 1985; Lambert, 1989; Dowsett-Lemaire, 1988) Green (1993) has dealt on the role of birds in the restoration of tropical forests in Australian region. According to Green (1993) frugivores can also be poor dispersers (disperse a few seeds), fruit thieves (eat fruits but leave the seeds on or under the tree) or seed predators (digest the seeds). Hence, it is imperative to know which bird in a community is the ideal disperser of a particular plant species of that area. In India, only a few studies have been undertaken (Ali, 1931; Vijayan, 1975; Balasubramanian, 1996; Balasubramanian *et al.,* 1998). Hence the present study was undertaken in an important landscape in Western Ghats. The study aimed to document avian frugivory and find out the plant species that depend on birds for seed dispersal and suggest such plants for restoration of the degraded landscapes.

Study Area

The study was carried out in Attappady (10° 55' - 11° 14' North latitudes and 76° 27' - 76° 48' East longitudes) and the adjoining Anaikatty reserve forests

*Attappady Hills Area Development Society, Agali (Kerala).

(11° 5' - 11° 31' North latitudes, 76° 39' - 76° 47' East longitudes) in the Western Ghats. Attappady is located at the middle eastearn portion of Kerala stretching over an area of 745 km^2 in Palakkad Revenue District touching the Nilgiri and Coimbatore districts of Tamil Nadu as its Northern and Eastern boundaries, respectively. The Ecosystem of Attappady is highly fragile due to its physiographical and meteorological characteristics. Excessive fragmentation of the land holdings and unscientific agricultural practices made the soil and vegetation in a poor state. The region is totally degraded, only remnant vegetation is found. Anaikatty Reserve Forest is a part of the Nigiri Biosphere Reserve, occurs at an elevation of 610 - 750 m amsl. This is an undulating terrain predominated by mixed dry deciduous forest.

Methods

Observations were carried out both in degraded and undisturbed sites. Degraded site comprised of small patches of mixed dry deciduous vegetation which are less dense occurring in Attappady. The undisturbed site occurs in Anaikatty, comprised of large patches of mixed dry deciduous forests. The study was carried out during October 2006 - September 2007.

Avian frugivory was documented by recording the activities of birds foraging on fruit-bearing plants. Two methods were followed; in the first method, extended watches were carried out in focal fruit bearing trees to record frugivore visitation. Plants selected for observation had drupes, berries or similar soft fruits having one or a few seeds or with composite fruits with many small seeds (Moraceae). The observer sat 10 m away from the focal plant, and observed the activities of avian visitors with the help of a pair of binoculars. Observations were usually done between 6.00 am and 9.00 am. The visit by each individual bird followed by pecking/ swallowing of fruits was considered as a fruit-feeding visit. In the second method, birds foraging on fruit-bearing plants were recorded while walking along the census transects. The number of birds in a foraging flock and the fruit species eaten by birds were noted. Most of the observations were done within four hours after sunrise, which is the most active foraging time for birds.

Results

Fruit-eating birds : During the extended bird feeding watches on 32 fleshy-fruited plant species, 29 fruit-eating birds were recorded (Table 1). Among the 29 fruit-eating species, *Psittacula krameri, P. columboides* are considered as seed predators as they mainly consumed the seeds. Remaining species of birds ate the fruits whole or partly, and regurgitated/ defecated the seeds and hence, considered as seed dispersers. Among the frugivore visitors, bulbuls (5 species) made highest number of feeding visits (45%), followed by mynas, 2 species (16%), babblers, 3 species (14.50%) and others that include barbets, koel, etc. Amog the bird species, Red-vented Bulbul *(Pycnonotus cafer)* (15.10%), followed by Red-whiskered Bulbul *(Pycnonotus jocosus)* (14.5%), White-browed Bulbul (*Pycnonotus luteolus)* (14.30%), Common Myna *(Acridotheres tristis)* (14.10%) and Yellow-billed Babbler *(Turdoides affinis)* (11.20%) were recorded as frequent frugivore visitors. These species visited large number of plant species as well as made frequent fruit

Table 1

Observed frugivory by birds during extended watches on fruit bearing trees

Sl. No.	Common Name	Scientific Name	# of visits	%
1.	Red-vented Bulbul	*Pycnonotus cafer*	781	15.10
2.	Red-whiskered Bulbul	*Pycnonotus jocosus*	747	14.50
3.	White-browed Bulbul	*Pycnonotus luteolus*	738	14.30
4.	Common Myna	*Acridotheres tristis*	725	14.10
5.	Yellow-billed Babbler	*Turdoides affinis*	579	11.20
6.	Asian Koel	*Eudynamys scolopacea*	339	6.50
7.	Copper-smith Barbet	*Megalaima rubricapilla*	205	3.90
8.	Jungle Babbler	*Turdoides striatus*	141	2.70
9.	Green-billed Malkoha	*Phaenicophaeus tristis*	118	2.30
10.	Crimson-throated Barbet	*Megalaima haemacephala*	113	2.20
11.	Brahminy Starling	*Sturnus pagodarum*	103	1.90
12.	Indian TreePie	*Dendrocitta vagabunda*	71	1.40
13.	Gold fronted Leafbird	*Chloropsis aurifrons*	68	1.30
14.	Common Iora	*Aegithina tiphia*	60	1.20
15.	House Crow	*Corvus splendens*	54	1.00
16.	Large Green Barbet	*Megalaima zeylanica*	49	0.90
17.	Eurasian Golden Oriole	*Oriolus oriolus*	43	0.80
18.	Rose-ringed Parakeet	*Psittacula krameri*	42	0.80
19.	Black Bulbul	*Hypsipetes madagascariensis*	41	0.80
20.	Blue-winged Parakeet	*Psittacula columboides*	39	0.70
21.	Rufous Babbler	*Turdoides subrufus*	33	0.60
22.	Indian Peafowl	*Pavo cristatus*	16	0.30
23.	Great Tit	*Parus major*	13	0.20
24.	Tickell's Flowerpecker	*Dicaeum erythrorhynchos*	12	0.20
25.	Grey-headed Bulbul	*Pycnonotus priocephalus*	8	0.60
26.	Grey Junglefowl	*Gallus sonneratii*	8	0.15
27.	Pompadour Green Pigeon	*Treron pompadora*	6	0.10
28.	Blyth's Reed Warbler	*Acrocephalus dumetorum*	5	0.09
29.	Thick-billed Flowerpecker	*Dicaeum agile*	1	0.01

feeding visits. About 70% of the fruit feeding visits were made by these five species. Hence, these species could be considered as major frugivores and seed dispersers of the study area. In addition, Koel (*Eudynamys scolopacea)* and barbets (*Megalaima spp*) were also found to be important for seed dispersal.

Bird-attracting plants : During the transect walk count, fruits of 40 plant species were found to be eaten by birds (Table 2). Among the 40 species, the exotic weed *Lantana camara* attracted maximum number of birds (22.97%). Notable native trees which attracted birds include *Santalum album* (4.28%), *Celtis philippensis* (3.41%), *Ficus*

Table 2

Bird-attracting plants observed in the study area

Sl. No.	Species	Habit	# of birds observed	% proportion	# of frugivorous species observed
1	2	3	4	5	6
1	*Lantana camara**	Shrub	580	22.55	11
2	*Flueggea virosa*	Shrub	158	6.14	11
3	*Ziziphus oenoplia*	Shrub	145	5.64	14
4	*Carmona retusa*	Shrub	112	4.35	7
5	*Cipadessa baccifera*	Shrub	135	5.25	8
6	*Santalum album*	Tree	108	4.20	8
7	*Scutia myrtina*	Shrub	106	4.12	7
8	*Breynia rhamnoides*	Shrub	101	3.93	9
9	*Celtis philippensis*	Tree	86	3.34	7
10	*Ficus racemosa*	Tree	85	3.30	10
11	*Trema orientalis**	Tree	74	2.88	6
12	*Flacourtia indica*	Tree	69	2.68	15
13	*Toddalia asiatica*	Straggler	65	2.53	5
14	*Canthium dicoccum*	Tree	64	2.49	15
15	*Syzygium cumini*	Tree	60	2.33	7
16	*Cassine glauca*	Tree	56	2.18	17
17	*Benkara malabarica*	Shrub	52	2.02	17
18	*Streblus asper*	Tree	51	1.98	9
19	*Pleurostylia opposita*	Tree	50	1.94	15
20	*Ziziphus mauritiana*	Tree	39	1.52	11
21	*Premna tomentosa*	Tree	35	1.36	6
22	*Pithecellobium dulce**	Tree	32	1.24	6
23	*Glycosmis pentaphylla*	Shrub	28	1.09	6
24	*Maba buxifolia*	Tree	27	1.05	6
25	*Cordia obliqua*	Tree	24	0.93	11
26	*Clausena dentata*	Shrub	23	0.89	7

Contd...

1	2	3	4	5	6
27	*Ficus religiosa*	Tree	19	0.74	6
28	*Ficus benghalensis*	Tree	18	0.70	21
29	*Glycosmis mauritiana*	Shrub	18	0.70	8
30	*Azadirachta indica*	Tree	16	0.62	2
31	*Ficus mollis*	Tree	15	0.58	8
32	*Ehretia laevis*	Tree	14	0.54	6
33	*Carissa carandas*	Shrub	12	0.47	8
34	*Ficus microcarpa*	Tree	12	0.47	17
35	*Diospyros montana*	Tree	12	0.47	10
36	*Carissa spinarum*	Shrub	10	0.39	7
37	*Murraya paniculata*	Shrub	6	0.23	5
38	*Mallotus philippensis*	Tree	6	0.23	2
39	*Cordia monoica*	Tree	1	0.04	1
40	*Capparis grandis*	Tree	1	0.04	1

*Exotics

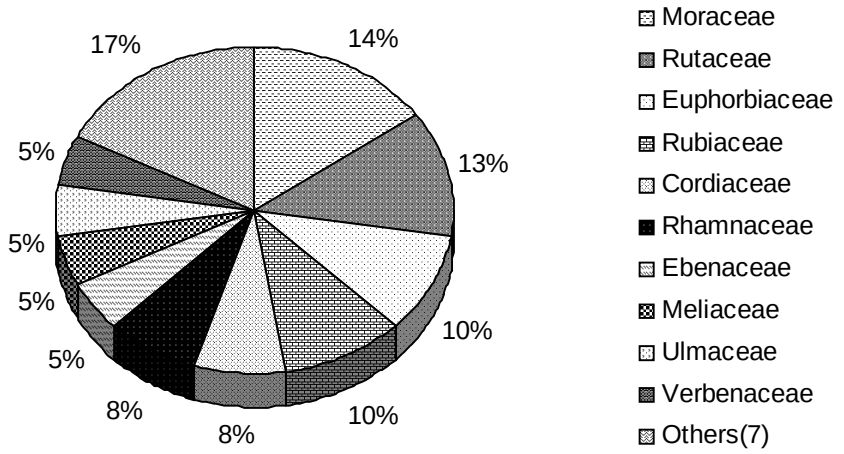
racemosa (3.37%), *Canthium dicoccum* (2.53%), *Syzygium cumini* (2.38%), *Cassine glauca* (2.22%) and *Streblus asper* (2.02%). Highest number of bird species was recorded in *Ficus benghalensis* (n=21) followed by *Ficus microcarpa, Benkara malabarica* and *Cassine glauca*, 17 species each.

A total of 17 plant families were found to attract avian frugivores in the study area. Predominant plant families that attracted frugivorous birds include, Moraceae (6 species), Rutaceae (5 species), Euphorbiaceae (4 species) and Rubiaceae (4 species) (Fig. 1). Moraceae, Rutaceae, Euphorbiaceae, Rubiaceae, Rhamnaceae and Verbenaceae members constituted about 60 % of the food plants for frugivores. Families that comprised only a few species but favoured by birds include Santalaceae, Meliaceae and Capparaceae. Important plant species for frugivores in the study area include *Ficus benghalensis, Ficus microcarpa* and *Ficus mollis* belonging to the family Moraceae.

Discussion

Fruiting plants that sustain frugivores during times of general fruit scarcity are known as "keystone species" (Leighton and Leighton, 1983; Terborgh, 1986a; Lambert and Marshall, 1991). They are of great ecological significance because they appear to set the carrying capacity of the frugivore community (Terborgh, 1986b). Fruiting fig trees attract highly diverse frugivores assemblages that disperse huge number of seeds over large areas. Figs (*Ficus*) have been identified as keystone plants for frugivore communities in South American and South-East Asian tropical forests during lean periods (Leighton and Leighton, 1983; Terborgh, 1986a; Kannan and James, 1999). In southern India, figs form a major diet of several avian frugivores. *Ficus* spp. (Moraceae)

Fig. 1



Dominant bird-attracting plant families in Anaikatty and Attappady (n=17)

supported diversity of avian frugivores in the study area; 21 species of avian frugivores fed on *Ficus* spp.

Birds are recognized as the main dispersal agent of many invasive plant species (Glyphis *et al.,* 1981; Dean and Milton, 2000; Stansbury, 2001; Renne *et al*., 2002). *Lantana camara*, an exotic shrub attracted large number of avian frugivores in the present study; 23% of feeding observations by birds were recorded on *Lantana camara*. Mishra and Mishra (1996) recorded eight species of birds eating *Lantana camara* fruits in Central India. Balasubramanian *et al* (1998) recorded 13 avian frugivores on *Lantana camara* in the Western Ghats. In the present study, 11 bird species were recorded to feed on *Lantana camara.* In all these sites bulbuls, mynas and barbets are found to be the major frugivores on *Lantana camara*.

Bulbuls have established themselves as one of the dominant frugivores and seed dispersers in scrub jungles or forests of secondary vegetation in Asia, Africa and the Middle East (Lever, 1987). Most species of bulbuls are frugivores and important seed dispersers. (Kitamura *et al*., 2002). Fruits comprised a major proportion of diet for *Pycnonotus luteolus* and *Pycnonotus cafer* in the tropical dry evergreen forest, Point Calimere, India (Vijayan, 1975). In Point Calimere, 74% of the feeding visits by birds on fruit bearing plants were made by two species of bulbuls, *P. cafér* and *P. luteolus* (Balasubramanian, 1996). In a dry mixed deciduous forest in Western Ghats, bulbuls are the predominant frugivorous and seed dispersing species (Balasubramanian *et al.,* 1998). In the sub-tropical shrublands of Hong Kong, two species of bulbuls Red-whiskered Bulbul (*Pycnonotus jocosus*) and

Light-vented Bulbul (*Pycnonotus sinensis*)were responsible for a large proportion of seed dispersal (Corlett, 1998, Weir and Corlett, 2007). In the present study, majority of the fruit-feeding visits (44.50%) were made by five species of bulbuls. It indicates that they are the principal frugivores and potential seed dispersers in the dry forest habitats across the tropics.

In conclusion, it is stated that to restore the degraded dry deciduous forest sites in Attappady, bird-attracting native tree species reported in the paper could be chosen for planting.

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SUMMARY

The Attappady Hills Area Development Society (AHADS) as part of eco-restoration programmes in Attappady hills, Western Ghats, initiated tree planting programmes to identify the bird-attracting species. Study sites were chosen in the degraded dry deciduous forests of Attappady and the adjoining Anaikatty reserve forests representing the mixed dry deciduous forest. Frugivorous birds were ascertained by making extended feeding watches on fleshy-fruited plant species and bird counts along transects. Twenty nine bird species were observed to eat fruits. Among the frugivore visitors, bulbuls (5 species) made highest number of feeding visits (45%), followed by mynas, 2 species (16%), babblers, 3 species (14.5%) and others. A total of 40 bird-attracting species were recorded in the study area. Moraceae represented by six species was found to be the most dominant bird-attracting family followed by Rutaceae and Euphorbiaceae. Among the 40 species, *Ficus benghalensis* attracted maximum number of avian frugivores followed by *Ficus microcarpa*, *Benkara malabarica, Cassine glauca* and *Canthium dicoccum*. A suggestion is made to plant the bird-attracting native species in the degraded sites of Attappady.

Key words **: Frugivory, Birds, Seed dispersal, Western Ghats.**

अट्टपाडि और अनैकट्टी पश्चिमी घाट प्रदेश के मिश्र शुष्क पर्णपाती वनों में बीज विकिरण में फल भक्षी पक्षियों की भूमिका

आर० अरुणा, पी० बालसुब्रामनियन् व पी० राधाकृष्णन्

सारांश

अट्टापाडि पर्वतीय क्षेत्र विकास परिषद ने अट्टापाडि पहाडियों पश्चिमी घाट प्रदेश के पुनस्थापन कार्यक्रमों के अंगस्वरूप पक्षियों को आकर्षित करती जातियों का पता लगाने के लिए एक वृक्षारोपण कार्यक्रम आरम्भ किया है। इसके अध्ययन स्थल अट्टापाडि के व्याह्वसित शुष्क पर्णपाती वनों और उनके साथ लगते अनैकट्टी आरक्षित वन में चुने गए जो मिश्र शुष्क पर्णपाती वन का प्रतिनिधित्व करते हैं। फलभक्षी पक्षियों का पता गूदेदार फल पादपों पर भोजन करते पक्षियों की विस्तारपूर्वक चौकसी करते और सक्षेत्रों के किनारे–किनारे पक्षियों की गिनती करके लगाया गया। उनत्तीस पक्षिजातियां फलों को खाती पर्यवेक्षित हुई। फलभक्षी आगन्तुकों में बुलबुले (पांच जातियां)

सर्वाधिक संख्या में भोजन करने वहां आई (45%), इसके बाद मैना (2%) जातियां (16%) सतभैया, 3 जातियां (14.5%) और अन्य पक्षि रहे। कुल मिलाकर 40 पक्षि आकर्षक पादप जातियां अधीत क्षेत्र से आलेखित की गई। इनमें वटकुल, जिसकी यहां छह जातियां थी सर्वाधिक बहुल पक्षि आकर्षक कुल पाया गया जिसके पश्चात निम्बु कुल और एरण्ड कुल आते हैं। 40 जातियों में से *फाइकस बेगालेसिस* ने फलभक्षी पक्षिजातों की अधिकतम संख्या को आकर्षित किया जिसके पश्चात *फाइकस माइक्रोकार्पा, बेंकांरा मलाबारिका, कैसाइन ग्लौका* और *कैन्थियम डायकोक्कम* आते हैं। अट्टापटि के व्याहसित स्थलों में पक्षियों को आकर्षित करने वाली देशज पादप जातियां रोपने का सुझाव भी दिया गया है।

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