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## Fruiting phenology and avian frugivory on *Lantana camara* in a mixed dry deciduous forest, Western Ghats, Tamilnadu, India

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### Abstract

This paper describes the fruiting phenology and avian frugivory of an exotic shrub *Lantana camara* L. - Verbenaceae) in a mixed dry deciduous forest, Anaikatty hills, Western Ghats. The fruiting season was recorded during May, June, July, August and September. Eleven species of birds were found to feed on the ripe fruits of *L. camara*. Majority of the fruit foraging visits were made by bulbuls (3 species) followed by Myna (2 species). Bulbuls and mynas appear to be the predominant seed dispersers of *L. camara*

**Keywords:** *Lantana camara*, phenology, avian frugivory, Western Ghats, Tamilnadu, India

### 1. Introduction

Avian frugivores are considered the most important seed dispersers in most ecosystems, as assessed by the numbers of successful propagules disseminated (Herrera 1995<sup>[14]</sup>, Stiles 2000<sup>[25]</sup>). Fruit-eating birds play a critical role in the functioning of tropical ecosystems and may assist in the natural regeneration of rain forests by dispersing seeds into cleared areas (Da Silva *et al.* 1996, Nepstad *et al.* 1996, Holl *et al.* 2000)<sup>[19, 9]</sup><sup>[19]</sup><sup>[15]</sup>. Birds are recognized as the main dispersal agent of many invasive plant species (Dean & Milton, 2000; Stansbury, 2001)<sup>[11]</sup>. Invasive plants are an increasingly significant conservation and economic problem worldwide. Although there are numerous examples of detrimental effects of plant invasions on ecosystem functions and individual species (Vitousek *et al.* 1996), there are also cases where invasive plants now perform important ecological functions (Westman 1990; Buckley *et al.* 2006)<sup>[3]</sup>. Invasive plant species that have the greatest impact on natural habitats are often trees or shrubs that are shade tolerant, grow rapidly, reproduce early, produce numerous seeds, and have fleshy fruits associated with bird-dispersal (Cronk and Fuller 1995)<sup>[8]</sup>.

Many highly invasive plants are fleshy-fruited and owe their invasiveness largely to mutualisms formed with local dispersers. The energetic benefits gained by frugivores from ingestion of fruits of invasive alien plants remain poorly documented. Complex dispersal patterns of fleshy-fruited invasive plants should be expected, as studies in systems without invasive plants emphasize a variety of frugivorous species consuming fruits from a single plant species (Kitamura *et al.* 2002)<sup>[16]</sup>.

The loss of indigenous fruiting species allows invasive alien species to penetrate ecosystems. Invasive species are sometimes preferred by frugivores and may therefore compete with native plant species for dispersal agents

(Lafleur *et al.* 2007)<sup>[17]</sup>. Many habitats now support both introduced fleshy fruited plants and introduced frugivores creating the potential for non-native species to promote each other's populations (Richardson *et al.* 2000)<sup>[4, 21]</sup>. There are several reasons to be particularly concerned about the addition of non-native species to avian-mediated seed-dispersal systems. Successful plant invasions have been attributed to particular fruit traits that enhance effective seed dispersal, and alien plants that have fruits that are preferred by frugivores are expected to be more invasive (Buckley *et al.* 2006)<sup>[3]</sup>.

### Study area

The major part of the research work was carried out in the tropical mixed dry deciduous forest of the Anaikatty hills of Nilgiri Biosphere Reserve, Western Ghats. This area is situated between 76°39' to 76°47'E and 11°5' to 11°31'N. This forest has an undulating terrain 610-

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-750 m with seasonal waterways with hilltops and south rising upto 1600msl. This area receives rainfall from both the monsoons but comparatively high during North-east monsoon. The mean annual rainfall of the area was lower than that of the moist deciduous forest zone of the country but was comparable to that of the mixed dry deciduous forest zone (Champion and Seth 1968) [5]. The forest is dominated by trees such as *Acacia leucophloea*, *Ziziphus mauritiana*, *Chloroxylon swietenia* *Albizia amara* etc. The area is also rich in wildlife.

**Focal study species**

***Lantana camara***

*Lantana camara* is a low, erect or subscandent shrub that grows upto 2 - 4 meters in height. The leaf is ovate or ovate oblong, arranged in opposite pairs. Flower heads contain 20-40 flowers, usually 2.5 cm across; the colour varies from white, cream or yellow to orange pink, purple and red. The fruit is a greenish blue-black colour, 5-7 mm in diameter, drupaceous, shining, with two nutlets. *Lantana camara*, a native of tropical America is found in 47 countries and has been described as one of the world's ten worst weeds (Cronk & Fuller 1995) [8]. *Lantana* was introduced to India in 1807 as an ornamental plant at the National Botanical Garden of Calcutta (Thakur *et al.* 1992). It soon escaped into the wild and has established itself all over the Indian subcontinent, stretching from the sub-montane regions of the outer Himalayas to the southernmost part of India. *Lantana* berries attract frugivorous birds and mammals that help to disperse its seeds widely.

The diverse and broad geographic distribution of *lantana* is a reflection of its wide ecological tolerances. It occurs in diverse habitats and on a variety of soil types. It generally grows best in open unshaded situations such as wastelands, rainforest edges, beachfronts, and forests recovering from fire or logging. Disturbed areas such as beside roads, railway tracks and canals are also favourable for the species (Thaman 1974; Winder and Harley 1983; Thakur *et al.* 1992, Munir 1996, in Day *et al.* 2003) [26] [10]. *Lantana* does not invade intact rainforests, but is found on its margins (Diatloff 1975; Humphries and Stanton 1992, in Day *et al.* 2003) [10]. Where wet sclerophyll forests and rainforests have been disturbed through logging, gaps are created; this allows *lantana* to encroach on the forests. Further logging aggravates the condition and allows the *lantana* to spread or become thicker (Waterhouse 1970, in Day *et al.* 2003) [10].

**Methodology**

**Phenology**

A total of 5 individuals were marked with aluminum tags and observed for phenology (Table 1).

The phenology of fruit production was observed twice in a month to assess the periodicity of fruiting. During the observation, percentage fruiting was noted for each tagged individual. Phenological observations were carried out for a continuous period of 1 year in the mixed dry deciduous forest, Anaikatty.

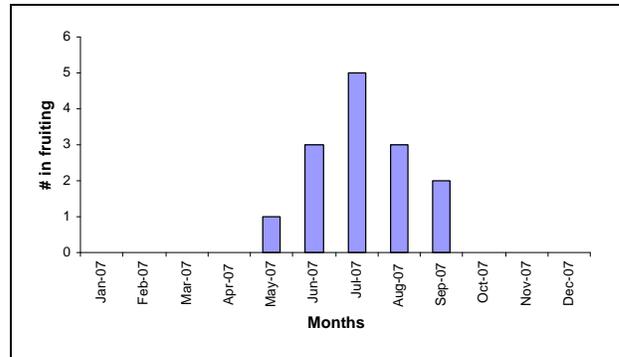
**Foraging Observations**

Foraging observations were made by extended bird feeding watches on fruit-bearing plants. Individual *Lantana* clumps were selected for extended feeding watches. Observations

were made between 6.00 and 9.00 hours on the bird visitation to the focal tree, with the help of binoculars. The visit by each individual bird followed by pecking/swallowing of fruits was considered as a fruit-feeding visit by a bird. Three individuals were observed for 12 hours each, totaling 36 hours of observation. Colours of ripe fruits for plant species were assigned to one of eight broad colour categories as used by Wheelwright and Janson (1985) [30]. Diameter of the fruits were measured by using a vernier caliper.

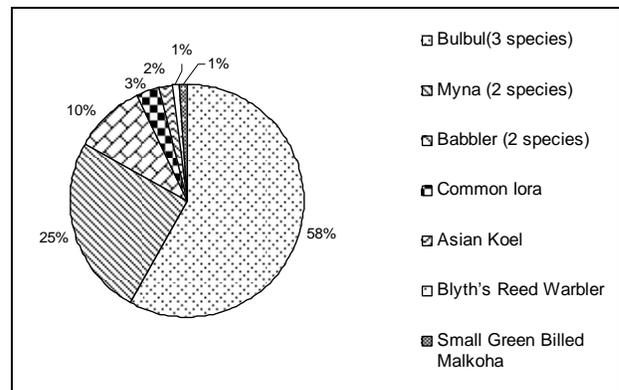
**Results**

Fruiting phenology: *Lantana camara* bore fruits during May, June, July, August and September. The fruiting peak was noticed in July with all the 5 tagged individuals in fruiting.

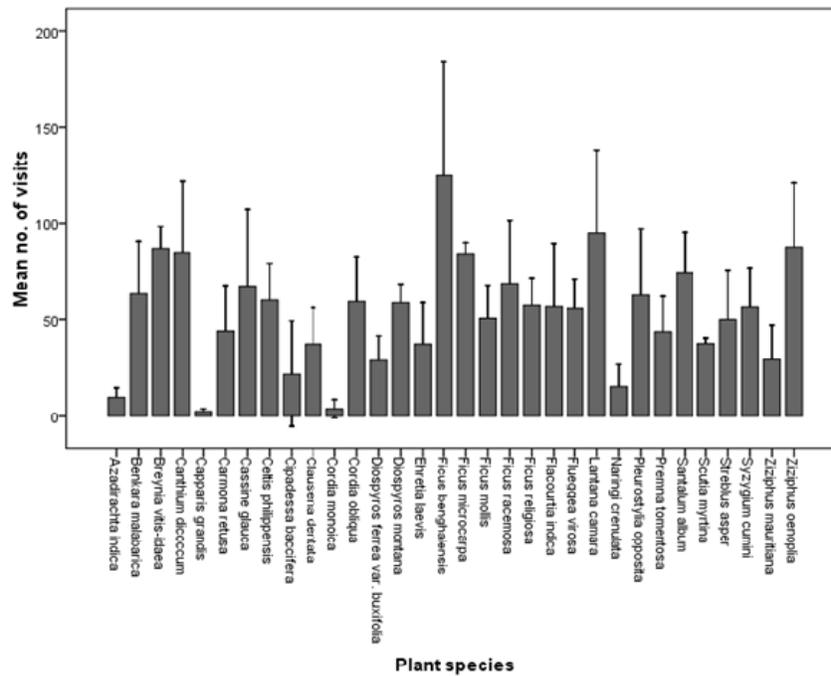


**Fig.1:** Fruiting phenology of *Lantana camara* in Anaikatty Avian frugivory on *Lantana camara*

Thirty six hours of observation was made on *L. camara*. A total of 285 feeding visits were made by birds. Eleven species of birds were found to feed on the ripe fruits of this species (Table 1). This included 3 species bulbuls, 2 mynas, 2 babblers, Asian Koel, Common Iora, Small Green-billed Malkoha and Blyth's reed Warbler. The majority of the fruit foraging visits was made by bulbuls followed by Mynas. White-headed Babbler, Asian Koel and Small green-billed Malkoha constituted other avian visitors to *Streblus asper*. Bulbuls were the most frequent visitors (58%), followed by mynas (25%), babblers (10%) (Figure 1). Red-vented Bulbul made maximum number of visits (26%), followed by Common Myna (22%) and Red-whiskered Bulbul (16%) (Table.1).



**Fig 2:** Avian frugivory on exotic *Lantana camara*



**Fig 3:** Mean number of visits on 32 fleshy fruited plant species (values in panels are mean  $\pm$  SE) in the tropical mixed dry deciduous forest.

Mean number of visits of birds were highest for *F. benghalensis* (124.67  $\pm$  SE 13.69), than other thirty one plant species, and the mean number of visits of birds differed significantly between the tree species ( $F_{31, 64} = 22.653$ ,  $P < .000$ ). The second plant species that attracted avian frugivores in terms of mean number of visits is *Lantana camara* (95.00  $\pm$  SE 10.01) in the study area.

### Discussion

Bulbuls formed the dominant frugivores of *Lantana camara*. Mean number of visits of birds to plants shows that *Lantana camara* supported large number of avian frugivores than the *Ficus* species. This clearly shows the importance of *Lantana camara* for the avian frugivores in the tropical mixed dry deciduous forest. Ten percent of *Lantana camara* fruits were fed by Red-vented Bulbul in Haridwar (Bhatt & Kumar 2001) [2]. *Lantana camara* constituted one of the preferred food plant species for Grey headed bulbul in the Silent valley National Park and Muthikkulam Reserve forests, Western Ghats, India (Vijayan and Balakrishnan 2005). According to Aravind *et al.* (2010), *Lantana* fruits are fleshy and available year-round, making them an ideal food source for frugivores such as bulbuls, who are one of the main dispersers Thirteen species of avian frugivores fed on *Lantana camara* fruits in Hong Kong shrubland (Corlett 1998) [6], while five species were reported to feed in urban Hong Kong (Corlett 2005) [7]. In continental areas, many indigenous bird species feed on the *Lantana* fruits, while on some of the island groups, seed dispersal have been mainly facilitated by the introduction of exotic bird species. By feeding on exotic species such as *Lantana*, birds may increase the density and distribution of the weed at the expense of native vegetation thereby displacing other bird species (Day *et al.* 2003) [10]. A study made in the Society Archipelago (French Polynesia) shows that bulbuls, Silver eye and Fruit doves fed on *Lantana camara* fruits. *Lantana* fruits were available throughout the year in this study and the same is also seen in Hong Kong,

south China, (Corlett 2005) [7] and South Africa (Graaff 1987) [13].

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