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Nest construction, characteristics and relationship between plant height and nesting density of Red Tree Ant (*Oecophylla smalagdiuna*) in Mayiladuthurai area of Cauvery Delta, Tamil Nadu, Southern India

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Abstract

The nest construction, characters and influence of plant height on the nesting density of arboreal nests of The Red Tree Ants (*Oecophylla smalagdiuna*) was assessed in Mayiladuthurai area of Tamil Nadu, southern India. The nests were observed in the tree species viz., *Azadirachta indica, Cassia fistula, Citrus* sp., *Citrus limon, Citrus medica, Erythrina indica, Gummiphora cardata, Mangifera indica, Morinda tinctoria, Odina wodier, Psidium guajava, Polyalthia longifolia, Pongamia glabra, Saraca indica, Syzygium cumini,* and *Thepesia populnea* and shrubs namely *Annona reticulate, Artobotrys odoratissimus, Hibiscus rosasinensis, Ixora coccinia, Jatropha curcas, Mussaenda erythrophylla, Plumbago* sp., and *Tecoma* sp. and climbers such as *Quissqualis indica,*and *Tiliochora accuminata.* The number of nests in a plant ranged from 1 to 12 nests/plant with an overall mean of 4.1± 0.28 nests/tree. The trees, shrubs and climbers had 71% (290 nests), 27% (110 nests) and 2% (8 nests) of nests respectively. The maximum numbers of nests were found in tree, *Morinda tinctoria*, shrub, *Annona reticulata* and climber *Tiliochora accuminata*. They constructed maximum number of nests in tertiary branch and most of the nests were triangular in shape. The multiple regression equation indicated that the nesting density was influenced by the plant height in quadratic fashion. The ants increased the nesting density in relation to height of the plants and reached an asymptote of 30ft and after which the density started to decline. This study indicated that the Red Tree Ants selected the nesting plants in relation to the nature and density of leaves and plant height.

Key words: leaf, nest construction, nest density, nest shape, plant type, tree height, Red tree ant

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INTRODUCTION

Social insects have permanent or perennial colonies viz., ants, termites, honeybees and stingless bees, and in which swarming occur (Frost, 1994). The ants are one of the most familiar and highly evolved social insects. They occupy the same position among the non-chordates as the man among the chordates (Kotpal, 1966). Colonies of many ant species can be regarded as functionally sessile organisms because nests remain fixed in space and time for many years (Thurber *et al*., 1993; Wiernasz and Cole, 1995), with the dispersion patterns of nests resulting from initial queen settlement and subsequent mortality.

The ants show the greatest variety in the construction of their nests. The eggs, larvae and pupae are kept in separate places. The most extraordinary nests are those made by certain ants of the genera *Oecophyla, Camponotus* and *Polyhachis* that occur in tropical. They construct nests of larvae and silk making a saclike structure in which the brood is raised (Frost, 1994). Hence the insects are master designers and engineers and have been constructing elaborate shelters for themselves for hundreds of millions of years, long before man appeared, termites are building skyscrapers, wasps are making paper and mortar, caterpillars are weaving in silk and ants are creating mounded metropolises (Farb, 1962).

The construction of nest and selection of appropriate nest-site are vital to the reproduction of any living organism because it determines the environment to which adults, eggs and young ones will be exposed during critical periods (Travaini and Donazar, 1994). Nest construction and site selection are important from the view point of population ecology as well, because it will have a limiting effect on the species distribution and abundance (Newton, 1979) and could affect the species' productivity (Simmons and Smith, 1985; Nagarajan, 2013). However, the biologists' usual assumption is that, nesting animals seek nesting substrate or trees which are unique and infer some benefits of them (Mosher and White, 1976; Titus and

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Mosher, 1981), may not hold good environments where the nesting substrates or trees are fairly uniform and common (Philpott and Foster, 2005).

Studies of the nesting behaviour of *Oecophyla* indicated that the nest tree selection is influenced by the nature of the leaves and species of plants (Nagarajan *et al*., 2007). The density and size of the nests vary in different species of plants. Hence, we aim to investigate the nest characteristics and plant height on the nesting density of Red Tree Ants (*Oecophylla smalaglina*) in different species of plants.

MATERIALS AND METHODS

Study Area

The research data were collected in Mayiladuthurai Taluk (Latitude 10°46′ N and Longitude 79° 5′ E) of Tamilnadu, Southern India. The area has wet agricultural lands which are irrigated by river Cauvery and its tributaries viz., Kollidam, Uppanar, Vellar, Manjalar, and Arasalar. The area is known as the 'Granary' of South India due to large scale agricultural operations involving cultivation of paddy, sugarcane, ground nut, banana, pulses and other cereals. The flat terrain has fine alluvial soil, and also sandy soil, sandy-clay soil and red soil can be seen sporadically. December-January is generally the coolest period and April-May is the warmest. The Northeast monsoon usually brings 65% of the total annual rainfall rain to the study area from October to December.

Nearly 150 species of plants have been recorded in the study area belonging to 49 families (Karunanithi, 1987). Woody vegetation is mainly in the form of groves. Woody plants with parse distribution are common in the garden on road sides and amidst human habitations. Predominant woody plant species found in the study area are *Cocos nucifera*, *Borrassus flabellifer, Madhuca indica, Mangifera indica, Samonea saman, Tamarindus indicus, Ficus benghalensis, Ficus religosa, Thespea populnea, Acacia arabica* and *Odina wodier*. Important shrub species are *Prosopis juliflora, Jatropha glandulifera* and *Adhathoda vesica*. Plantations of *Cauarina equilitilia* and *Bamboosa arundinacea* are also found in the study area.

Study Period: The data were collected from August 2007 to February 2008.

Nesting Density and Nesting Plant Characteristic Features

Nesting Density: The density of nests of the Red Tree Ants (*Oecophylla smalagdina*) was assessed by counting all the individual nests which were active.

Plant Species: The name of the nesting plant species was noted.

Plant Type: The type of plant was noted either as plant, shrub, and climber.

Nesting Plant Height: The height of the nest tree and nest were measured, visually as proportion of observer height.

Nesting Tree Canopy Extension: The extension of the canopy from the main stem was measured using the scale, from the basal area to tip of the canopy extension.

Statistical Analysis

The relationship between nesting density and plant height was investigated by using multiple regression equation. Initially the nature of relation between the nesting density and nesting tree height and canopy extension was assessed using the scatter plots. The independent variables such as plant height and nesting tree canopy extension were entered in the equation with higher order terms. All the statistical inferences were made by using Sokal and Rohlf (1981).

RESULTS

Nesting Tree Selection and Construction

The nests of Red Tree Ants (*Oecophylla smalagdiuna*) were observed in the tree species viz., *Azadirachta indica, Cassia fistula, Citrus* sp., *Citrus limon, Citrus medica, Erythrina indica, Gummiphora cardata, Mangifera indica, Morinda tinctoria, Odina wodier, Psidium guajava, Polyalthia longifolia, Pongamia glabra, Saraca indica, Syzygium cumini,* and *Thepesia populne.* The nests also found in shrubs namely *Annona reticulate, Artobotrys odoratissimus, Hibiscus rosasinensis, Ixora coccinia, Jatropha curcas, Mussaenda erythrophylla, Plumbago* sp., and *Tecoma* sp. and climbers viz., *Quissqualis indica,* and *Tiliochora accuminata* (Table 1).

They constructed their arboreal nests mainly by using fresh green leaves in all the plant species. The ants jointed the leaves of nesting plant together by means of silken threads. Majority of time they selected the trees which had broad and smooth leaves. The leaves were folded in various directions to make the nests. They used the live, fresh and green leaves intact for nest construction. They started the nest with two or three leaves as simple construction and expand the same nest into a complex one using several leaves. The age of nests can be assessed from the size and components of the nests. Often the bigger old nests had ripened or dried leaves. Frequently several nests were seen in a single plant and the nests were placed close each other. Each sac like nest was surrounded by well protected leaves and the leaves were cemented through the whitish silky material. Such an arrangement provided the sturdy structure and shape to the nests. Each nest had a definite entrance. The nest was constructed within a day and also whenever

there was a damage to the nest that was attended by the individuals immediately to repair the damage.

Totally 106 trees were sampled and in which 408 nests were located. The number of nests in a plant ranged *Pongamia glabra* (8.82%) among the tree species. In shrubs, the maximum numbers of nests were observed in *Annona reticulata* (8.33%) followed by *Ixora coccinia* (6.86%) and *Hibiscus rosasinensis* (5.64%). The climber, *Tiliochora accuminata* (1.72%) had highest number of nests among the climbers (Table 1).

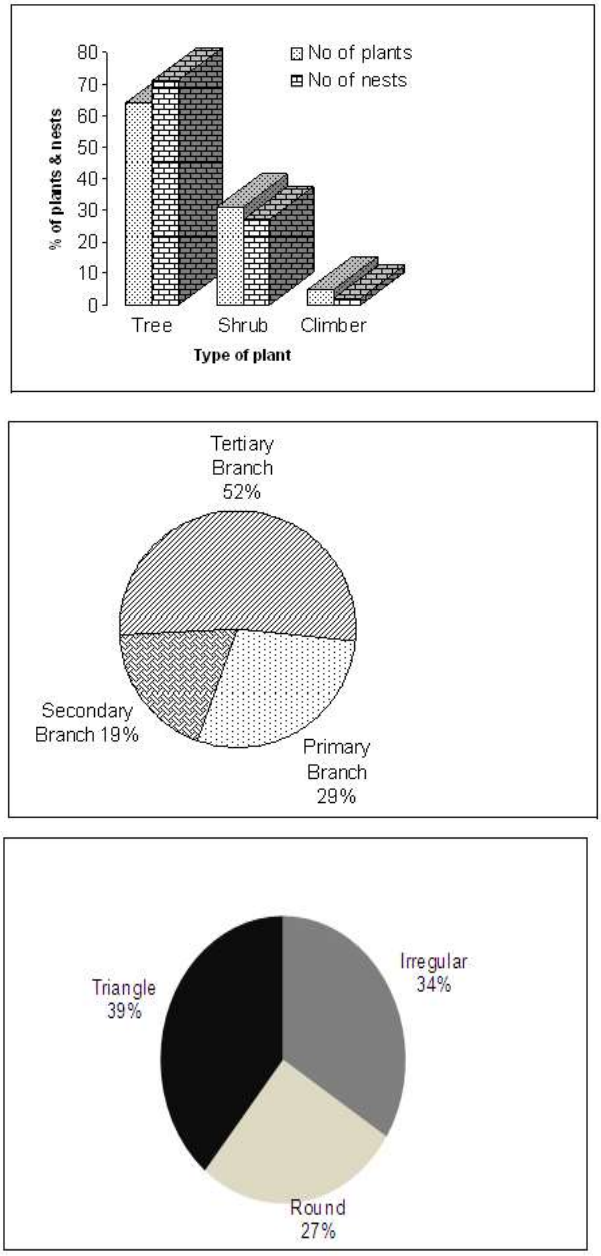

Fig. 1. Percentage of nests of Red Tree Ants (*Oecophylla smaragdina*) in different plants categories, in different branches of the plants and different shapes constructed by Red Tree Ants in Mayiladuturai Taluk, Tamil Nadu, Southern India.

Table 1: Number and percentage of nests of Red Tree Ants (*Oecophylla smalagdiuna*) observed in different plants species in Mayiladurai Talk, Tamil Nadu, Southern India during the study period.

S. No.	Species Name	Number of plants	%	Number of nests	%
	Trees				
1	*Azadirachta indica*	4	3.77	15	3.68
2	*Cassia fistula*	1	0.94	8	1.96
3	*Citrus* sp.	2	1.89	12	2.94
4	*Citrus limon*	3	2.83	10	2.45
5	*Citrus medica*	1	0.94	9	2.21
6	*Erythrina indica*	2	1.89	2	0.49
7	*Gummiphora cardata*	2	1.89	4	0.98
8	*Mangifera indica*	9	8.49	49	12
9	*Morinda tinctoria*	12	11.3	55	13.5
10	*Odina wodier*	1	0.94	10	2.45
11	*Psidium guajava*	2	1.89	5	1.23
12	*Polyalthia longifolia*	1	0.94	3	0.74
13	*Pongamia glabra*	11	10.4	36	8.82
14	*Saraca indica*	1	0.94	9	2.21
15	*Syzygium cumini*	4	3.77	28	6.86
16	*Thepesia populnea*	12	11.3	35	8.58
	Shrubs				
17	*Annona reticulata*	6	5.66	34	8.33
18	*Artobotrys odoratissimus*	1	0.94	8	1.96
19	*Hibiscus rosasinensis*	14	13.2	23	5.64
20	*Ixora coccinia*	6	5.66	28	6.86
21	*Jatropha curcas*	1	0.94	1	0.25
22	*Mussaenda erythrophylla*	2	1.89	3	0.74
23	*Plumbago* sp.	2	1.89	5	1.23
24	*Tecoma* sp.	1	0.94	8	1.96
	Climbers				
25	*Quissqualis indica*	1	0.94	1	0.25

The Red Tree Ants constructed nests in different branches of the plants. They constructed a maximum number of nests in tertiary branch (52%) followed by secondary (29%) and in few cases in the primary branch (19%). The numbers of nests in different shapes were counted and the maximum number of nests were triangular nests (39%) followed by irregular shape (34%) and rectangular shape (27%) (Fig. 1).

Relationship Between Nesting Plant Height and Nesting Density

The relationship between nesting plant height and nesting density was investigated using multiple regression equation model. The nesting density was used as dependent variable against plant height as predictor variable. It is observed that the height had quadratic relationship with nesting density. The

regression equation explained 11.7%of the total variation and the equation was significant. The canopy height was entered in the equation and found that it did not have significant effect on the nesting density. From the scatter plots and regression model it was found that the ants increased the nesting density (mean) in relation to height of the plants. The density reached an asymptote of 30ft and after which the density started to decline (Fig. 2).

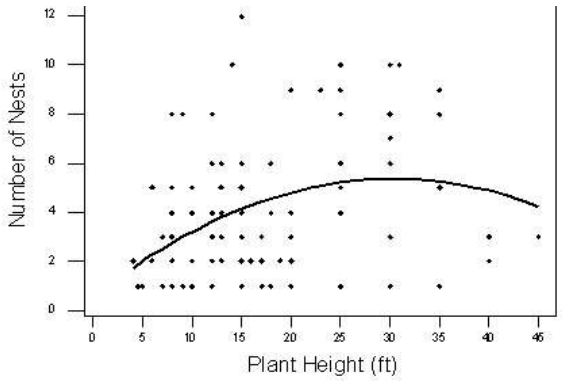

Fig.2. Multiple regression equation to investigate the factors influencing the nesting density of Red Tree Ants (*Oecophylla smaragdina*).

The regression equation is: Total No of Nests=0.5599 + 0.3176 Plant Height - 0.0052 Square of Plant Height (R^2=11.7%; P<0.001). The quadratic fitted line is drawn on the scatter plot.

DISCUSSION

The Red Tree Ants (*Oecophylla smalagdiuna*) jointed the leaves of nesting plant together by means of silken threads. Majority of time they selected the trees which over the edges of the leaves. Material from the silk glands adheres to the leaf when the mouth parts of the ants are pressed against it. As the larvae are moved toward the opposite leaf, silken threads are spun which are attached to it. This is continued until the leaves are properly joined. The silk is fine and delicate and many strands must be spun to form the entire nest. Vast numbers of larvae are required to complete the job (Frost 1994). Hence nesting habits of arboreal ants ranged from subterranean localities to arboreal nests incorporating silk produced by the ants' own larvae (nest weaving) (Robson and Kohout, 2005). We found that Red Tree Ants constructed a wide variety of nests in different shapes such as triangular, rectangular nests and irregular shape as well. Farb (1962) and Frost (1994) narrated that the most extraordinary nests are those made by certain ants of the genera.

In the present study the Red Tree Ants constructed their arboreal nests in the tree species viz., *Azadirachta indica, Cassia fistula, Citrus* sp., *Citrus limon, Citrus medica, Erythrina indica, Gummiphora cardata, Mangifera indica, Morinda tinctoria, Odina wodier, Psidium guajava, Polyalthia longifolia, Pongamia glabra, Saraca indica, Syzygium cumini,* and *Thepesia populnea.* The nests also found in shrubs namely *Annona reticulate, Artobotrys odoratissimus, Hibiscus rosasinensis, Ixora coccinia, Jatropha curcas, Mussaenda erythrophylla, Plumbago* sp., and *Tecoma* sp. and climbers such as *Quissqualis indica,*and *Tiliochora accuminata.* All these plants have long and broad leaves which could be the reason to select these plants for nesting. Furthermore, these plants provide short and well protected canopy for the ants to travel between trees. Dejean (2000) reported that arboreal-nesting ant species (*i.e., Oecophylla longinoda, Polyrhachis laboriosa*, two large Formicinae and *Tetramorium aculeatum*, a small, nocturnal Myrmicinae) used entire leaves of *Macaranga hurifolia* in order to build their nests, while the compound leaves of *Bridelia micrantha* make their installation difficult. Furthermore, Sadhashivam *et al*. (2002) reported that *Oecophylla smaragdina* was reported for the first time from the Pichavaram mangroves building leaf nests on *Rhizophora apiculata* and *Rhizophora mucronat* which had broad leaves but stiff in nature.

In this study, maximum numbers of nests were found in *Morinda tinctoria* (13.48%) followed by *Mangifera indica* (12.01%) and *Pongamia glabra* (8.82%) among the tree species. In shrubs the maximum numbers of nests were observed in *Annona reticulata* (8.33%) followed by *Ixora coccinia* (6.86%) and *Hibiscus rosasinensis* (5.64%). The climber *Tiliochora accuminata* (1.72%) had highest number of nests among the climbers. These trees have broad thin leaves which can be folded easily to make the nests.

The Red Ant Tree Ants constructed maximum number of nests in tertiary branch (52%) and most of the nests were triangular (39%) in shape. The construction of nests in tertiary branch would offer two benefits, this branch has denser canopy and extended to the neighbouring tree. Hence the ants would have easily manipulated many leaves to construct the bigger nests and would have got access to neighbouring trees for food collection and other activities.

It is observed that the height had quadratic relationship with nesting density. The model indicated that the ants increased the nesting density (mean) in relation to height of the plants. The density reached an asymptote of 30ft and after which the density started to decline. The taller trees (more than 30 ft) are exposed well above the denser canopy. Such taller trees are shaken by high winds. Therefore the nest may get destroyed in high winds. Furthermore these trees are exposed well and visibility could be much better. Hence these trees can attract some bird predators. Because of these reasons the ants could have avoided more than 30ft tall trees for nest constructions.

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