Chapter

Roost-Tier Preference in Roost-Trees: A Case Study in the Bats *Pteropus giganteus*

Susanta Mallick, Asif Hossain and Srimanta Kumar Raut

Abstract

The Indian flying foxes *Pteropus giganteus* are habituated to spend the day hours roosting in suitable roost trees. They are seen hanging here and there in a roost tree. It is not known whether they have preferred roost sites rather hanging spots in the concerned roost tree. To testify the said hypothesis we selected two roost trees, *Albizia lebbeck* and *Tamarindus indica* locating at distant places (75 km apart) in the arid zone of West Bengal, India during the period of last ten years. It is revealed that *P. giganteus* preferred branches of the roost tree which are locating in the mid-tier of tree. But depending upon the situations the less preferred sites are not spared as these sites are used by the late comers. Statistical tests following application of one-way ANOVA justified significant effect of the roost branch on the abundance of bat population ($P<0.05$), abundance of bats in the roost branches is highly correlated in respect to the study years ($r=0.96$) is also justified from the study of normality distribution plot, and the results of GLMM strongly support the hypothesis irrespective of the variables, that is branches of the roost tree and the year of observations ($P = 0.0$).

Keywords: *Pteropus giganteus* bats, roost tree, roost branches, roost-tier preference

1. Introduction

Bats roost mostly in caves and trees. These roost sites are degrading day by day because of unpredictable human activities [1] especially due to destruction of roost trees at large [2–11]. Customarily tree roosting bats select certain aged trees having well developed canopy area [9, 12–14] it is not clearly known which part of a roost tree is preferred by the bats and why? Or there exists no discretion in respect to roost site selection in a tree.

The Indian flying foxes *Pteropus giganteus* [15] found in India, Bangladesh, Nepal, Bhutan, China, Maldives, Myanmar, Pakistan and Sri Lanka [16]. These frugivorous flying mammals are habituated to spend the day hours at the roost sites specially in selective trees in open spaces [2, 4, 6, 13, 17, 18]. Mostly; these bats select big, well branched and leafy trees for roosting. As there exists many branches of a roost tree and usually the branches are gradually smaller in length with increasing height of the tree we aimed to study the preferential sites, if any, the bats considered for hanging. Accordingly, we selected two roost trees *Albizia lebbeck* (L.) Benth and *Tamarindus indica* (L.) locating at distant places in the village area. The

results, we obtained are very much impacted by the intra-specific competition even if these bats are socially well organized and the members of a colony are guided by the social bindings to carry out allotted duties assigned for the well being of the colony members.

2. Materials and methods

We selected two roost-trees for the proposed studies. Of the two, one, the silk flower tree *Albizia lebbeck* (16.15 m in height, umbrella shaped crown, 1637.96 m^2 in canopy area with 1.73 m in diameter) with five main branches bearing thin foliages. This tree is deciduous in nature. It is located in the village Joteghanashyam (22°31′10.0”N, 87°50′19.2″ E) of Paschim Medinipur district. The second roost-tree *Tamarindus indica* (17.67 m in height, umbrella shaped crown, 1960.79 m^2 in canopy area with 3.33 m in diameter) with 14 main branches bearing thick foliages. This is evergreen in nature. It is located in the village Simla (23°22′44.20”N, 86°38′47.02″ E) of Purulia district, 75 km west of silk flower tree; these two districts are locating in the arid zone of state of West Bengal, India.

In *A. lebbeck*, of the five main branches, the longest one was 15 m in length while the smallest one was confined to 7 m. In contrast, in *T. indica* the longest branch was 13 m and the shortest one was 3 m in length. In both cases such measurements were taken on the last sampling dates. Irrespective of roost-trees there were numerous short sub-branches at certain points along the extended parts of the main stem from the point of emergence of the main stem body.

These branches from the lower to upper part of the tree were marked as L_1, L_2, L_3 and so on depending upon the number of branches occurring successively up to the top of the tree. Thus in case of *A. lebbeck* branches were numbered as L_1 to L_5 and for *T. indica* the same was ranged from L_1 to L_{14}. The lower most branch of *A. lebbeck* and *T. indica* was 5.79 m and 1.78 m above the ground respectively. We counted the number of bats hanged in respect to the marked branch including the sub-branches of the same and the data were recorded at monthly interval. We used binocular as and when necessary to locate the bats to avoid any kind of ambiguity in counting of the bats. The counting was initiated on 25 April 2011 and continued up to 30 March 2021 at Joteghanashyam, and from 19 January 2015 to 23 December 2020 at Simla.

3. Statistical analysis of the data

Data collected were pooled together to estimate the average number of bat individuals selected the specific branch of the roost trees, irrespective of months of the study years as well as the standard error (SE) values. One-way ANOVA was applied to justify whether the branches have significant effect in selecting the same as roost sites by the bats. Normal probability Plot of PAST Software was used to ascertain and justify the normal distribution of the roosting bats in different branches of the roost trees. GLMM was applied to testify the proposed hypothesis by determining the overall significance levels ($P<0.05$).

4. Results

It is revealed that the roosting abundance of *P. giganteus* varied from 73.31±6.52 to 217.19±20.88 in *A. lebbeck* at Joteghanashyam (**Figure 1**) and

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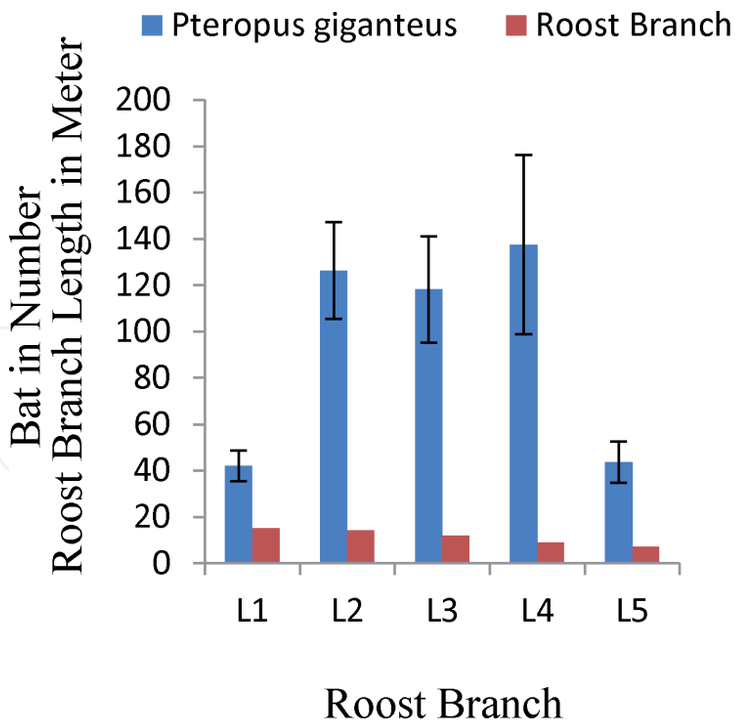

Figure 1.
Mean (±SE) number of P. giganteus *bats used the branches of the roost tree* A. lebbeck *daily during 2011–2021 study periods at Joteghanashyam.*

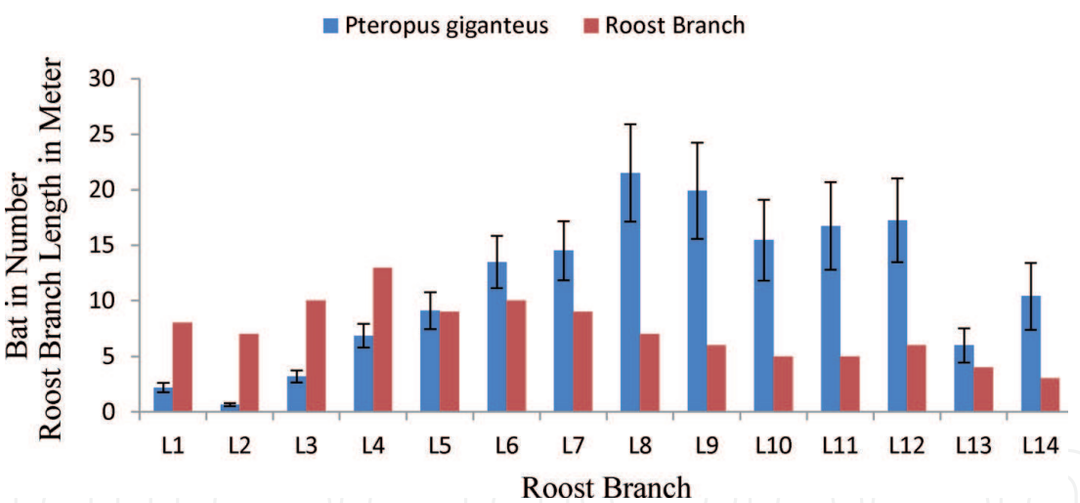

Figure 2.
Mean (±SE) number of P. giganteus *bats used the branches of the roost tree* T. indica *daily during 2015–2020 study periods at Simla.*

1.12±0.13 to 37.64±4.39 in *T. indica* at Simla (**Figure 2**) per roost branch. Results of ANOVA test clearly indicate that there exists significant differences in selection of the roost sites by *P. giganteus* in *A. lebbeck* (df=14, F=5.71, P=0.00, N=540) and *T. indica* (df=12, F=2.05, P=0.00, N=373). From the normality distribution plot (**Figures 3** and **4**) it is evident that there exists significant correlation between abundance of roosting bat population and the study years. GLMM studies (**Table 1**) confirmed that the roost sites occupied by *P. giganteus*, in the branches of both the roost trees (except one branch L_1 in *A. lebbeck* and two branches L_2 and L_3 in *T. indica*) are undoubtedly preferred sites for roosting (P=0.0) depending upon the probability of availability of these sites upon their time of return to the roost tree.

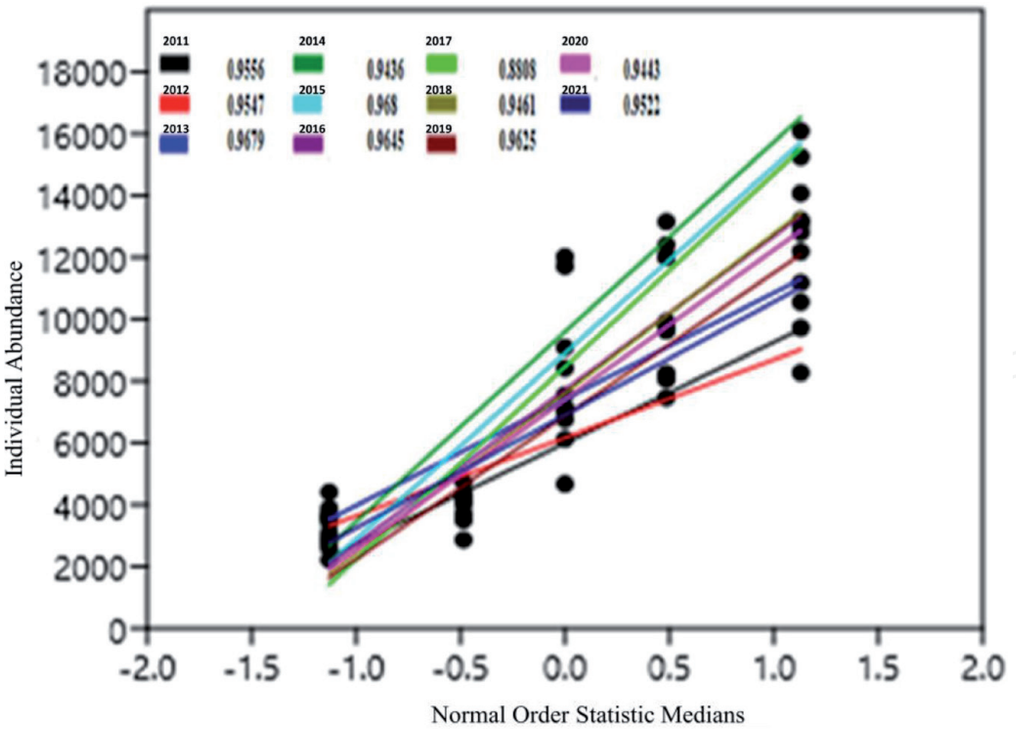

Figure 3.
Normal probability distribution of P. giganteus *in* A. lebbeck *roost tree during study years (2011–2021) at Joteghanashyam.*

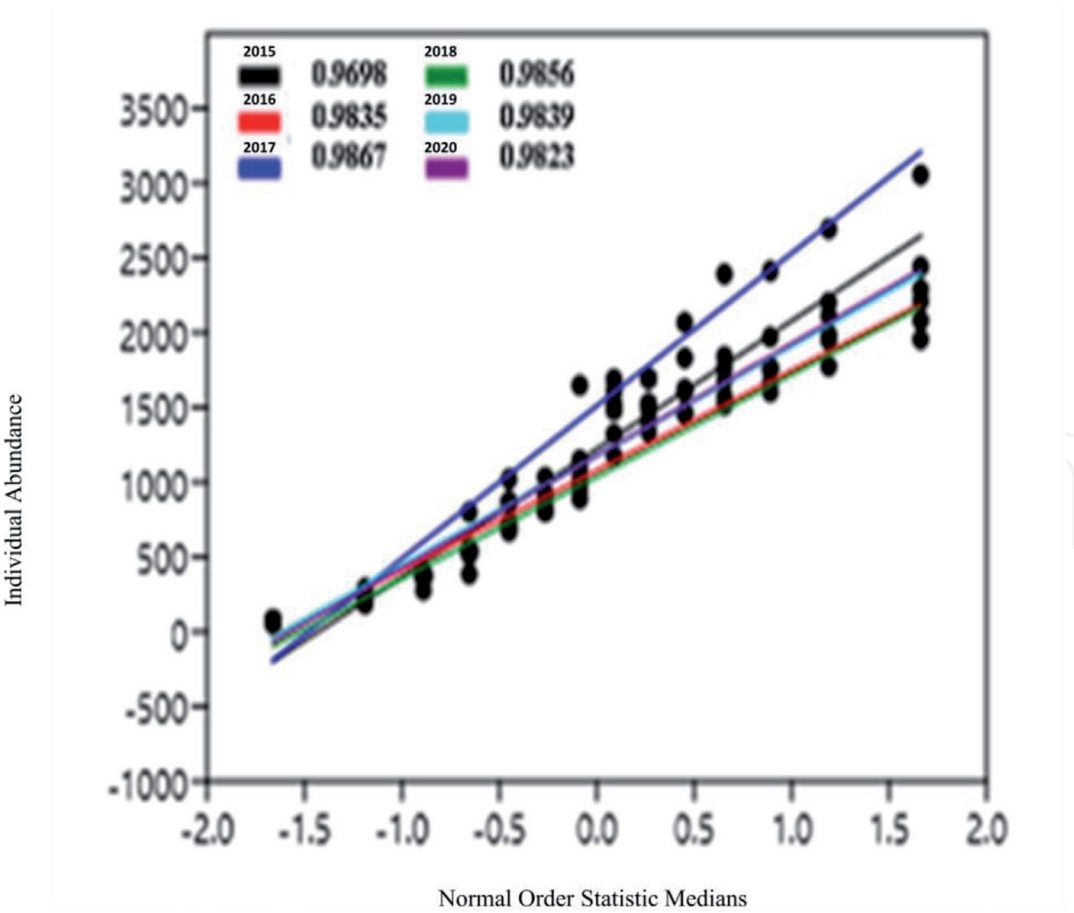

Figure 4.
Normal probability distribution of P. giganteus *in* T. indica *roost tree during study years (2015–2020) at Simla.*

Albizia lebbeck				*Tamarindus indica*			
Variables	**Estimate**	**T-value**	**P**	**Variables**	**Estimate**	**T-value**	**P**
(Intercept)	3598.7273	5.1964979	0	(Intercept)	239.3333	2.426218	0
BLL2	7063.3636	7.3529123	0	BLL2	−169.3333	1.614338	>0.05
BLL3	6005.3636	6.2515416	0	BLL3	119.5000	1.139252	>0.05
BLL4	6528.5455	6.7961703	0	BLL4	557.1667	5.311744	0
BLL5	156.6364	0.1630574	>0.05	BLL5	780.1667	7.437713	0
				BLL6	1285.0000	12.250537	0
				BLL7	1383.3333	13.187997	0
				BLL8	2100.5000	20.025100	0
				BLL9	1881.3333	17.935677	0
				BLL10	1361.6667	12.981438	0
				BLL11	1495.0000	14.252571	0
				BLL12	1599.5000	15.248821	0
				BLL13	355.8333	3.392334	0
				BLL14	730.8333	6.967394	0

Table 1.
Results of GLMM studies on roost-tier (branch length L1=BLL1 to BLL5 in Albizia lebbeck*; branch length L1=BLL1 to BLL14 in* Tamarindus indica *and in both sites BLL1 acts as intercept) preference in roost-trees of the bat* P. giganteus *in* A. lebbeck *at Joteghanashyam and* T. indica *at Simla, West Bengal, India.*

5. Discussion

Various workers [5, 6, 8, 9, 12–14] have paid due attention on the choice and selection of trees for roosting by the bats. Though they have paid due attention on DBH, canopy nature, foliages and age of the roost trees no information in respect to preference of roosting branches is on record. From the results it is evident that the bats *P. giganteus* have preference for roost sites in a roost tree. And, from the present findings it is clear that these bats have a priority to avail the opportunity to hang in the branches occurring at the mid sector of the tree. As they are colonial in habit and all the members of a colony are habituated to use the same roost tree if and when possible, the late comers have no alternative but to hang in the branches where spaces are available, even these branches being less preferred.

The bats *P. giganteus* left the roost tree at the onset of darkness to fly to the foraging sites. Depending upon the availability of food sources some individuals being well fed at the early hours may try to return the roost tree as early as possible, perhaps to take the shelter in the preferred branches of the roost tree. This kind of behavior most probably related with the assurance of individual's safety from the effect of adverse conditions viz. the attack by the predators [19], speed of the severe cyclonic wind [20] extremely high temperature and heat being exposed directly to the sunlight, direct hit of the rain drops, extreme cold waves during cooler months and loo during summer [21].

Thus, we hypothesized that the bats *P. giganteus* have preferred roost tiers in a roost-tree to ensure self protection through the exercise of their subtle intra-specific competition.

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None declared.

Conflict of interest

There exists no conflict of interest.

Research ethics and best practices

The guidelines on Animal Ethics, supplied by the University Grants Commission, New Delhi were followed to carry out this work.

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