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NEST-SITE CHARACTERISTICS OF YELLOW-LEGGED GREEN-PIGEON, *TRERON PHOENICOPTERA* IN A TROPICAL EVERGREEN FOREST PATCHES OF EASTERN ASSAM, INDIA

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ABSTRACT
Columbidae (pigeons and doves) is one of the most threatened bird families in the world yet it has received relatively little attention for conservation. We surveyed Yellow- legged Green-pigeon at Jeypore Reserve forest to study their nesting habitat and nest-site characteristics during two breeding seasons in 2008 and 2009. Parameters of nest sites were measured and enumerated using specific habitat quantification methods. A total of twenty nest trees were located during the survey and twelve nest-site parameters were measured and analyzed. It was found that nest trees differ significantly from centre trees of non-nest plots in terms of size. There have also been differences in the other nest tree variables such as GBH, height of tree etc of nest plots and centre tree variables of non- nest plots. PCA performed extracted three principal components which explained 74.81% variability. Apart from these, twenty potential nest tree species of Yellow-legged Green-pigeon that occurred in the 0.25 ha plots were identified. Bombax ceiba and Tetramelos nudiflora are the most common tree species among them and their overall occurrence were 4.5 trees/ha and 3.0 tree/ha respectively. Nesting attempts were recorded on 20 nests. Of the total nests located, 60.9% nests were successful as squabs were hatched in these nests while 39.1% were unsuccessful.

INTRODUCTION

The Yellow-legged Green-pigeon *Treron phoenicoptera* belongs to the Columbidae family and is a least concern species throughout its range (Birdlife International, 2010). They belongs to important frugivorous bird groups of tropical forests ecosystem performing valuable services in seed dispersal and forest regeneration (Stiles, 1985; Corlett, 1998; McConkey *et al.,* 2004) and in some cases are the only vector by which seeds of certain tree species are dispersed (Meehan *et al.,* 2005). Data on their ecological and biological aspects is deficient as very few studies have been conducted on the Columbidae group as a whole (Wiley and Wiley, 1979; Burger *et al.,* 1989; Steadman, 1997; Bancroft *et al.,* 2000; Strong and Johnson, 2001; Walker, 2007). The Yellow-legged Green-pigeon is widely distributed throughout the Indian Sub-Continent and is a commonly sighted frugivorous bird in the tropical forests of eastern Himalayas (Ali and Ripley, 1987). Very few studies have been conducted on columbids in India (Ali and Ripley, 1987) and some studies are mostly based on morphological adaptations (Bhattacharya, 1994) and nesting behaviour (Devi and Saikia, 2012). Birdlife International (2010) placed this species under least concern category owing to its wide distribution and abundance but, its eco-biological data is deficient. Thus, the present study has been carried out to highlight the data on nest site characteristics and nesting ecology of Yellow-legged Green-pigeon.

MATERIALS AND METHODS

Study area

The Jeypore reserve forest is located at Dibrugarh district of Upper Assam which falls between 27º06' – 27º16' N L and 95º21' – 95º29' E L. The total area of the reserve is 108 km^2. The terrain of the reserve is slightly undulating and is continuous with the forests of Arunachal Pradesh. Burhi-Dihing and the Dilli rivers forms a part of the reserve boundary. Many small perennial streams and nullahs also flow within the forest. Swamps and grassland patches also occurs inside the forest (Kakati, 2004). This forest is a part of an important IBA- the Upper Dihing West Complex, IBA Site No. IN-AS-45 and is notified as a reserve forest way back in 1888 (Kakati, 2004). The habitat is Tropical Rainforest, Champion and Seth (1968) described it as "Assam Valley Tropical Wet Evergreen Forest" (category 1B/ C1) also called the Upper Assam *Dipterocarpus – Mesua* Forest. The forest is characterized by a top canopy dominated by *Dipterocarpus macrocarpus* reaching heights of 50m, a middle canopy dominated by *Mesua ferrea* and *Vatica lanceaefolia* and undergrowth consisting of woody shrubs such as *Saprosma ternatum, Livistonia jenkinsiana* and canes *Calamus erectus* etc. (Kakati, 2004).

Methods

We studied the Yellow-legged Green-pigeon at Jeypore Reserve forest between January 2008 and December 2009 for two years breeding seasons and made observations on its nesting site characteristics and nesting habitats. For understanding nest site characteristics and factors determining nest site selection of Yellow-legged Green-pigeon

Nest-sites characteristics such as tree species, girth at breast height (GBH), height of the nest tree, height of first branch of

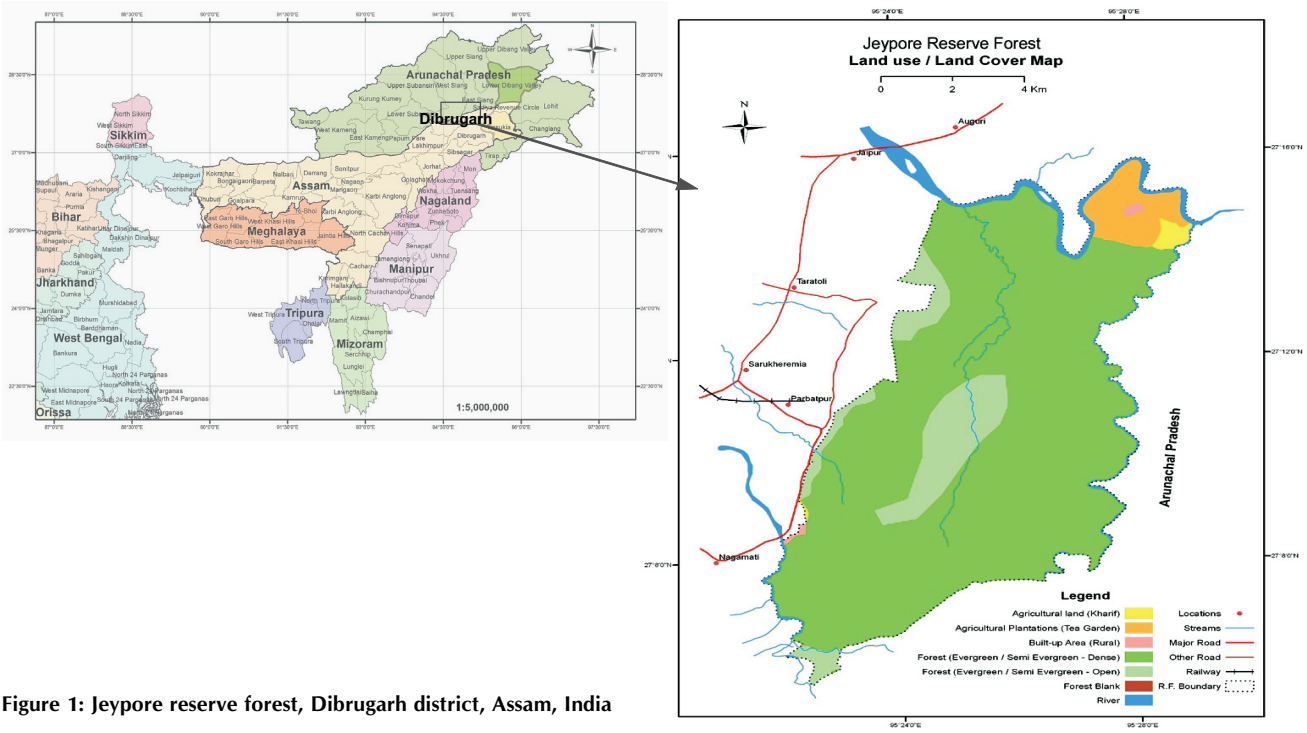

Figure 1: Jeypore reserve forest, Dibrugarh district, Assam, India

nest tree, distance to road, river and habitations were measured. Other parameters such as canopy cover and ground covered were also measured. Density of all trees of GBH e" 25cm were measured and enumerated around the nest sites, taking the nest tree as centre of a 50×50 m plot to determine the characteristics of the nesting habitat used by the pigeons. The quantification of nesting habitat followed methods suggested by James and Shugart (1970) and subsequently by Mudappa and Kannan (1997). Data on nest trees and nesting habitat parameters were measured.

All statistical analysis was carried out using EXCEL and SPSS 17.0 software. Descriptive statistics and non- parametric tests were used wherever appropriate (Zar, 1974). Principal Component Analysis was used to understand nest site selection by pigeons (Pielou, 1984).

RESULTS

Nest site characteristics

A total of twenty nest trees of Yellow-legged Green-pigeon were located. Of these, six nest trees were in open forests while the remaining fourteen were located near forest edges.

Table 1: Characteristics of nest-site and non-nest site plots of yellow-legged green-pigeon

S. No.	Parameters	Nest Plot (n = 20)	Non- nest Plot (n= 20)	t	P
1	*Nest /Centre tree height (m)	40.75 ± 2.03	36.15 ± 1.25	2.359	0.029*
2	*Nest /Centre tree GBH (cm)	264.7 ± 15.78	249.05 ± 9.57	1.192	0.248
3	Height of Nest from Ground (m)	30.9 ± 1.78	Nil	Nil	Nil
4	Height of the first branch of Nest/ Centre tree (m)	23.2 ± 1.23	21.5 ± 0.81	1.835	0.082
5	Height of Tallest tree in the plot (m)	46.9 ± 1.41	44.65 ± 0.97	1.815	0.085
6	Distance of Nest/Centre Tree to the tallest Tree (m)	3.25 ± 0.37	4.3 ± 0.38	3.462	0.003*
7	Distance of nest/ centre tree to Habitation (m)	14.95 ± 2.33	15.9 ± 1.71	-0.783	0.443
8	Distance nest/ centre tree to Road (m)	16.7 ± 1.74	17 ± 1.32	-0.325	0.749
9	*Distance nest/ centre tree to River (m)	58.75 ± 8.78	45.8 ± 4.97	2.719	0.014*
10	Canopy cover (%)	50.48 ± 3.29	49.2 ± 2.48	0.181	0.858
11	Ground Cover (%)	33.45 ± 2.91	31.2 ± 2.82	2.359	0.029*
12	Tree density/ha				
	i) Trees of GBH ≥ 25cm	55.5 ± 1.84	47.8 ± 1.99	3.242	0.004*
	ii) Trees of GBH ≥ 26- 75 cm	10.95 ± 1.02	8.15 ± 0.91	2.536	0.12
	iii) Trees of GBH ≥ 76- 125 cm	8.95 ± 0.95	7.65 ± 1.06	1.931	0.069
	iv) Trees of GBH ≥ 126- 175cm	6.9 ± 0.76	5.65 ± 0.76	1.699	0.106
	v) Trees of GBH ≥ 176- 225 cm	8.8 ± 0.91	6.85 ± 0.93	2.655	0.016*
	vi) Trees of GBH ≥ 226- 275 cm	4.7 ± 0.61	4.2 ± 0.65	2.364	0.029*
	vii) Trees of GBH ≥ 276- 325cm	4.1 ± 0.51	3.15 ± 0.54	1.791	0.089
	viii) Trees of GBH ≥ 325cm	1.5 ± 0.34	1.6 ± 0.33	-1.71	0.104

*Parameters that was significantly different between nest and non-nest plots*Significant level is at $p < 0.05$

Twelve nest site and non-nest site variables were measured (Table 1). Nest trees differed significantly from centre trees of non-nest plots, in terms of size. The height of the tree, girth at breast height (GBH) and distance to nearest rivers/streams were significantly greater in nest trees than non-nest centre trees (Table 1). But there was no significant difference in height of the first branch, height of the tallest tree in the plot, distance to tallest tree, distance to habitation and road canopy cover and ground cover between nest plots and non-nest plots, differences were only associated with the structural (architecture of the trees) characteristics like tree height and girth between nest tree and centre tree of the non-nest plot. However, there was a significant difference in overall tree densities such as (trees of GBH e" 25 cm, GBH e" 176- 225 cm and GBH e" 226- 275 cm) between the nest and non-nest plots but, no difference between larger girth trees of GBH greater than 325 cm (Table 1).

Principal component analysis

The Principal component analysis (PCA) was carried out using the nest site characteristics data from all the nests of Yellow-legged Green-pigeon observed (n = 20). Table 8 shows the Pearson's correlation matrix between the 11 variables.

PCA extracted three principal components that explained 74.81 % variability (Table 2). The first component explained 39.36 % variability that explained six nest tree variables such as girth at breast height (GBH), nest tree height, height of nest from ground, height of the first branch, height of the tallest tree and distance to the tallest tree in the plot and that were positively correlated with the first component. High values on the first component correspond to the large girth of nest trees, tallness of nest trees, first branch and nest height that are high above the ground. Thus, the first component represents, with increasing values, the size of the nest tree and tallness will also increase. The second component explained 19.29% variability that explained six other nest tree variables such as nest tree height, height of the nest from ground, distance to road, distance to river, canopy cover and tree densities (Table 2). High values on the second component correspond to a high tree density, nest tree tallness and greater distance from road and river/ streams. Thus, the second component represents, with increasing values of dense forests, greater distance from roads and river/streams hence lower degree of disturbance. The third component explained 15.85% of the total variance and was related to nest tree height, tree density and distance to road side (Table 3).

Potential nest tree species and availability of yellow-legged green-pigeon

Twenty potential nest tree species of Yellow-legged Green-pigeon that occurred in the sixteen 0.25 ha plots in the study area were listed below (Table 4). Of these 10 species *Anthocephalus cadamba, Bombax ceiba, Mesua ferrea, Michelia champaca, Michelia oblonga, Pithecellobium monadelphum, Sapium baccatum, Terminalia myriocarpa, Tetramelos nudiflora* and *Toona ciliata* were used for nesting

Table 2: Pearson's correlation co-efficient matrix between nest tree variables of yellow-legged green-pigeon

	Girth at Breast Height	Nest Tree height	Height t of nes	Ht. of first branch	Ht. of tallest tree	Distance to tallest tree	Distance to habitation	Distance to road	Distance to river	Canopy cover	Tree density
Girth at Breast Height	1										
Nest Tree height	.548*	1									
Height of nest	.451*	.862**	1								
Ht. of first branch	.621**	.891**	.919**	1							
Ht. of tallest tree	.701**	.858**	.686**	.729**	1						
Distance to tallest tree	-.240	-.588**	-.460*	-.444	-.575**	1					
Distance to habitation	.153	.103	-.053	.018	.162	.043	1				
Distance to road	.126	-.222	-.168	-.125	-.135	.199	.478*	1			
Distance to river	.125	-.015	.187	.032	-.044	-.191	.287	.550*	1		
Canopy cover	.249	.075	-.129	-.017	.160	-.236	-.073	-.100	-.114	1	
Tree density	.283	-.070	-.120	-.068	.210	-.142	-.179	-.154	-.054	.721**	1

* Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).

Table 3: Summary statistics of the principal component analysis (PCA)

Nest tree Variables	Communality	PC1		PC2		PC3	
		r	C	r	C	r	C
Girth at Breast Height	0.653	0.315*	0.704	-0.384	0.017	0.069	0.397
Nest Tree height	0.933	0.288**	0.951	0.242*	0.058	0.129*	0.157
Height of nest from ground	0.868	0.203**	0.874	0.166*	0.189	-0.041	0.262
Height of first branch	0.887	0.336*	0.917	-0.237	0.127	0.094	-0.172
Height of tallest tree	0.841	0.219*	0.910	-0.286	-0.054	0.064	0.104
Distance to tallest tree	0.442	0.127*	-0.648	-0.186	0.130	0.161	-0.070
Distance to habitation	0.531	-0.053	0.060	0.241	0.588	0.195	0.426
Distance to road	0.805	0.224	-0.179	0.143*	0.672	0.260*	0.566
Distance to river	0.566	-0.100	0.074	0.159*	0.596	0.340	0.453
Canopy cover	0.819	0.096	0.151	0.281*	0.651	0.009	0.611
Tree density	0.851	0.167	0.111	0.350*	0.687	0.115*	0.606
Eigen Value			4.329		2.123		1.744
% of variance explained			39.357		19.297		15.853

* Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).

Table 4: Potential nest tree species, tree characteristics and availability of Yellow- legged Green-pigeon at the study area

S. No	Tree species	Tree height (in feet)	Wood type	Foliage type	Overall tree density/ha	Tree density/ ha (GBH≥ 250cm)
1	*Ailanthus grandis*	56 -101	Softwood	Deciduous	1.75	1.25
2	*Alstonia scholaris*	44 - 85	Softwood	Evergreen	0.5	0
3	*Anthocephalus cadamba*	32 - 74	Softwood	Deciduous	1.25	0.75
4	*Artocarpus chaplasha*	52 - 85	Moderately hard	Deciduous	1.75	1.5
5	*Bombax ceiba*	40 - 105	Softwood	Deciduous	2.25	1.75
6	*Canarium resiniferum*	45 - 110	Softwood	Evergreen	0.75	0.25
7	*Dipterocarpus macrocarpus*	88 - 144	Hardwood	Deciduous	1.75	0.75
8	*Gmelina arborea*	42 - 75	Softwood	Deciduous	1.25	1
9	*Mesua ferrea*	31 - 62	Hardwood	Evergreen	0.5	0.25
10	*Michelia champaca*	45 - 88	Softwood	Evergreen	0.75	0.5
11	*Michelia oblonga*	41 - 88	Softwood	Evergreen	1.25	0.75
12	*Pithecellobium monadelphum*	25 - 85	Softwood	Deciduous	1.5	0.5
13	*Sapium baccatum*	43 - 105	Softwood	Deciduous	0.25	0
14	*Shorea assamica*	62 - 110	Softwood	Deciduous	0.75	0.25
15	*Stereospermum chelonoides*	54 - 86	Hardwood	Deciduous	1.25	0.75
16	*Tectona grandis*	58 - 112	Hardwood	Deciduous	0.75	0.5
17	*Terminalia myriocarpa*	39 - 95	Hardwood	Evergreen	1	0.75
18	*Tetramelos nudiflora*	58 - 118	Softwood	Deciduous	2.25	1.25
19	*Toona ciliata*	22 - 56	Softwood	Deciduous	0.25	0
20	*Vitex pentaphylla*	40 - 120	Hardwood	Deciduous	0.5	0.25

by Yellow legged Green pigeon in the study area. Apart from these, the pigeons were found to make nests on *Terminalia chebula* which was not recorded in the study plots. All of these trees were emergent, large girth trees and were relatively more common than other species. In fact, *Bombax ceiba* and *T. nudiflora* were the most common tree species among those trees. The overall occurrence of *T. nudiflora* and *Bombax ceiba* was 4.5 trees per ha and 3.0 per ha for trees of GBH e" 250cm which were recorded in the sixteen 0.25 ha plots covering an area of 4 ha during the study period (Table 4).

The other species included in the list were *Ailanthus grandis, Alstonia scholaris, Artocarpus chaplasha. Canarium resiniferum, Dipterocarpus macrocarpus, Gmelina arborea, Shorea assamica, Sterospermum chelonoides, Stercilua alata, Tectona grandis* and *Vitex pentaphylla* (Table 4). The overall density of three species *Alstonia scholaris*, *Sapium baccatum* and *Toona ciliata* were 1.0 per ha recorded in the sixteen 0.25 ha plots, but no large tree of GBHe" 250cm for these species were recorded in the study plots thus they were regarded as uncommon species (Table 4).

Apart from wood type and tree size, the overall availability of the species must be important factors in the nest tree selection by Yellow-legged Green-pigeon as well. In the study plots covering 4 ha, the overall availability of trees was 22.25 per ha (89 trees) and of large size tree of GBHe" 250 cm was 13.0 per ha (52 trees) including 17 species (Table 4).

Nest competitors and predators

The most commonly seen predators of Yellow-legged Green-pigeon nests in the study area were birds of prey such as hawks (e.g. *Accipiter badius, Accipiter trivirgatus etc.*) and kites (e.g. *Milvus migrans*). There were also competitions between common crows and the pigeons as during entire incubation periods and post hatching period, the breeding

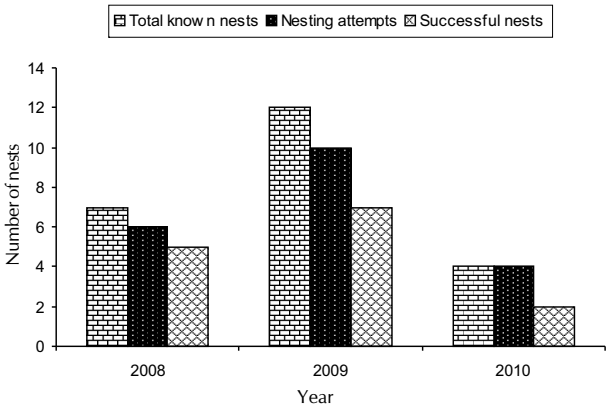

Figure 2: Number of Yellow-legged Green-pigeon nests located, nesting attempts and nesting success during 2008- 2010

Table 5: Causes of unsuccessful nesting attempts of yellow-legged green-pigeon (2008-2010)

Year	No. of known nests unsuccessful	Causes	Remarks
2008	1	Nest tree breakage	Disturbance
2008	1	Destroyed by storm	Open nests are easily susceptible to heavy storm
2009	1	Abandoned	Unknown
2009	1	Heavy Storm	Breaking of tree branch where the nest was located
2009	1	Abandoned	Incomplete nest
2009*	1	Abandoned	Unknown
2009	1	Heavy Storm	Nest blown away by heavy wind
2010	1	Nest tree cut	Disturbance?
2010*	1	Abandoned	Nest was located on low height

*Secondary information, ?not directly sighted

pairs were seen frequently chasing away crows that have tried to snatch the squabs from the open nests. Apart from that, in certain cases, the Mynas such as *Acridotheres tristis* and *Acridotheres fuscus* were seen competing with the pigeons for nest materials as the mynas were observed removing the nest materials from the pigeon's nests and the breeding pairs had a tough time chasing away the intruders. Rats, snakes and squirrels were other animal species seen to attack Yellow-legged Green-pigeon's nests in the study area.

Nesting attempts and success

Of the total 23 nests located during study, nesting attempts were made on twenty nests (86.9%) and the remaining three were considered unsuccessful. Of the total 23 nests, nine (39.1%) nests were unsuccessful, while fourteen nests (60.9%) were successful as squabs were hatched on those nests. The unsuccessful nests were either destroyed by storm or abandoned due to extensive disturbances (Table 5). The detailed of the number of total known nests in each year for Yellow-legged Green-pigeon and number of nesting attempts and successful nests were given in Fig. 2.

To determine whether nesting attempts were affected by disturbance, differences in tree density and distance to human habitation and road (indicators of degree of disturbance) between the successful and unsuccessful nests were tested. There was no significant difference in tree density (Paired samples t-test, $t = 0.214$, $p = 0.836$), distance to habitation (Paired samples t-test, $t = 0.216$, $p = 0.834$) and distance to roads (Paired samples t-test, $t = 0.398$, $p = 0.701$) between successful and unsuccessful nests.

DISCUSSION

The Jeypore Reserve forest is one among the few remaining tropical forest patches of eastern Assam which is unique for its varied avian fauna (Saikia and Devi, 2011). Very few studies on Columbids were conducted in India (Bhattacharya, 1994; Devi and Saikia, 2012). The present study was in fact one of the few attempts to gather valuable data regarding the bird's nesting ecology. From the study it was indicated that, the Yellow-legged Green- pigeon uses tall, emergent, large girth trees for nesting. The existence of above 50 % nests trees near forest edges have indicated that, the birds are least affected by disturbances as some of the nests are encountered very near to human habitation. Columbids nesting in tall, emergent trees near degraded forest edges were also reported earlier by few renowned scientists (Wiley and Wiley, 1979; Steadman, 1997). The results show variation among the parameters of nest site and non- nest site plots in terms of size and tree densities. Of the twenty potential nest trees selected from sixteen 0.25ha plots, ten are used by the pigeons for nesting during two successive breeding seasons. *Bombax ceiba* and *Tetramelos nudiflora* are the most common tree species among them. Of the total nests located, 60.9% are successful and 39.1% nests are unsuccessful as the nests are either destroyed by storm or abandoned due to much disturbance. As most of the pigeon species make open nests (Wiley and Wiley, 1979; Steadman, 1997, Bancroft *et al.,* 2000), nest destruction before hatching of squabs by storms and strong winds are very common occurrence as in case of Yellow-legged Green-pigeon also in the study area. It may be mentioned that the present population status of *Treron phoenicoptera* in the wild is unknown but evidences suggest that the species might be facing serious threat from habitat loss and hunting (Walker, 2007). Thus long term population monitoring of the species and ecological studies are required immediately. Conservation programs should also focus on these least studied important frugivores that are abundantly available now-a-days but it might become rare and threatened in near future if left unchecked.

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REFERENCES

Ali, S. and Ripley, S. D. 1987. *Handbook of Birds of India, Pakistan and Srilanka*. Oxford University Press, Delhi. p. 700.

Bancroft, G. T., Bowman, R. and Sawicki, R. J. 2000. Rainfall, Fruiting Phenology and Nesting Season of White- Crowned Pigeons in the Upper Florida Keys. *The Auk*. **117(2):** 416- 426.

Bhattacharya, B. N. 1994. Diversity of feeding adaptations in certain columbid birds: A functional morphological approach. *J. Bioscience*. **19(4):** 415- 427.

Birdlife International. 2010. Species factsheet: *Treron phoenicopterus*. Downloaded from http://www.birdlife.org on 14/9/2010.

Burger, J., Gochfeld, M., Gochfeld, D. J. and Saliva, J. E. 1989. Nest Site Selection in Zenaida Dove (*Zenaida aurita*) in Puerto Rico. *Biotropica*. **21(3):** 244- 249.

Corlett, R. T. 1998. Frugivory and Seed dispersal by Vertebrates in the Oriental (Indo-Malayan) region. *Biological Reviews*. **73:** 413-448.

Devi, O. S. and Saikia, P. K. 2012. Notes on the nesting behaviour of Yellow-footed Green-pigeon *Treron phoenicoptera* (Columbidae) at Jeypore Reserve Forest, Assam. *J. Threatened Taxa*. **4(3):** 2470-2475.

James, F. C. and Shugart, H. H. 1970. A quantitative method of habitat description. *Audubon Field Notes*. **24:** 727-736.

Kakati, K. 2004. Impact of Forest Fragmentation on the Hoolock Gibbon in Assam, India. *PhD Thesis*. Wildlife Research Group, Department of Anatomy, Cambridge University. p. 230.

McConkey, K. R., Meehan, H. J. and Drake, D. R. 2004. Seed dispersal by Pacific pigeons (*Ducula pacifica*) in Tonga, Western Polynesia. *Emu*. **104:** 369- 376.

Meehan, H. J., McConkey, K. R. and Drake, D. R. 2005. Early fate of *Myristica hypargyraea* seeds dispersed by *Ducula pacifica* in Tonga, Western Polynesia. *Austral Ecology*. **30:** 374- 382.

Mudappa, D. and Kannan, R. 1997. Nest- site characteristics and nesting success of the Malabar Grey Hornbill in the Southern Western Ghats, India. *Wilson Bulletein*. **109(1):** 102- 111.

Pielou, E. C. 1984. Interpretation of Ecological Data: A Primer on Classification and Ordination. John Wiley, New York. p. 263.

Saikia, P. K. and Devi, O. S. 2011. A checklist of avian fauna at Jeypore Reserve Forest, eastern Assam, India with special reference to globally threatened and endemic species in the Eastern Himalayan biodiversity hotspot. *J. Threatened Taxa*. **3(4):** 1711-1718.

Steadman, D. W. 1997. The Historic Biogeography and Community Ecology of Polynesian Pigeons and Doves. *J. Biogeography*. **24(6):** 737- 753.

Stiles, F. G. 1985. On the role of birds in the dynamics of neotropical forests. In *Conservation of Tropical Forest Birds* (*eds*. J. M. Diamond and T. E. Lovejoy), pp. 49-212. ICBP, Cambridge, UK.

Strong, A. M. and Johnson, M. D. 2001. Exploitation of Seasonal Resource by Non- Breeding Plain and White-Crowned Pigeons: Implications for Conservation of Tropical Dry Forests. *The Wilson Bulletin*. **113(1):** 73- 77.

Walker, J. S. 2007. Geographical patterns of threat among pigeons and doves (Columbidae). *Oryx*. **41(3):** 289- 299.

Wiley, J. W. and Wiley, B. N. 1979. The biology of White Crowned Pigeon. *Wildlife Monographs*. **64:** 1-54.

Zar, J. H. 1974. Biostatistical Analysis. Prentice-Hall, Engelwood cliffs, N. J., USA. p. 718.