Research Paper

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Distribution of Pteropodid Bats in Tirunelveli, Tuticorin and Kanyakumari Districts of Tamilnadu, South India

Biology

KEYWORDS: Distribution, Richness, Megachiroptera, C. sphinx, P.giganteus

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ABSTRACT

This study was mainly done to access the distributional pattern of megachiropterans in the plains of Tirunelveli, Tuticorin and Kanyakumari districts of Tamilnadu, South India. Three species of megachiropterans ie., C. sphinx, R. leschenaulti and P. giganteus was observed to present in this area. On evaluating the species richness, Tirunelveli district was observed to have a higher value (C. sphinx Dmg = 1.497 , R. leschenaulti Dmg = 0.724 and P. giganteus Dmg = 0.609) than that of the other two districts.

INTRODUCTION

Bats form the second largest mammalian order, representing a quarter of all mammals [1]. They belong to the Order Chiroptera and on the basis of their specialization in feeding habits and morphological adaptations; bats are broadly classified into two sub orders Megachiroptera and Microchiroptera. Megachiroptera are predominantly fruit eaters and Microchiroptera, which form the majority of bat species globally, feed mostly on insects. The distributional study made by Bates and Harrison [2] on Indian bats is found to be an important guide for chiropterologists. Ecology related studies of megachiropterans are very few and found to be crucial considering the rate at which habitat available for them are being lost [3]. Distribution, survey and ecological studies are found to be important, because they not only bring out knowledge about the diversity of bat fauna but also on the habit and habitat requirements and the conservation strategies of bats [4]. A total of 120 species of bats is found to be present in India including 14 species of Megachiropteran bats [2]. Distributional and habitat studies would help to evaluate the species richness, dominance and evenness in the area which will be helpful in developing strategies for conservation of animals. Species richness is a measure used as an indicator of diversity of animals. Kunz [5]reported that the richness and diversity of bats depends on the availability of food sources and identical roost sources.

This study was done in the southern most part of Tamilnadu, which is situated in the foot hills of southern Western Ghats. A very few studies related to the distribution of bats have been done during the past years in this area i.e., tent construction in Cynopterus sphinx [6], distributional study on microchiropterans [7], and movement of Indian flying fox [8].

On the whole, information available on distribution of megachiropterans in this part of the Indian sub continent is found to be very scanty. Hence the present investigation was made to survey the megachiropterans in the Tirunelveli, Tuticorin and Kanyakumari districts of Tamilnadu and to evaluate the species richness, dominance and evenness.

MATERIALS AND METHODS

a. Study Area

1. Tirunelveli district

Tirunelveli the penultimate southern most district of Tamil Nadu, is described as a microcosm of the state, owing to its mosaic and diverse geographical and physical features such as lofty mountains and low plains, dry teri structures, rivers and cascades, seacoast and thick inland forest, sandy soils and protected wild life. Tirunelveli district lies between 08o 8' and 09o 23' N latitude and 77o 09' and 77o 54' E longitude.

2. Tuticorin district

Tuticorin district is bounded by the Bay of Bengal and districts of Tirunelveli, Kanyakumari and Ramanathapuram. This district has also got diverse geographical and physical features such as lofty mountains and low plains, dry Teri structures, seacoast and thorny scrub jungles. It lies in 08º 45'of N latitude and 78º 13' E longitude.

3. Kanyakumari district

Kanyakumari is the southern most district of Tamil Nadu. The district lies between 77o 15' and 77o 36' E longitudes and 8o 03' and 8o 35' N Latitudes. The district has a favourable agro-climatic condition, which is suitable for growing a number of food crops and roosting habitat for bats.

B. Survey

Survey on distribution of megachiropteran bats was conducted in the plains of Tirunelveli, Tuticorin and Kanyakumari districts of Tamilnadu, South India for a period of one year from June 2011 to May 2012. Periodic visits were made to the bat roosting sites throughout the plains. Bat roosts were located based on the local enquiries from the people. Field visits were made to observe the diurnal roosting sites of pteropodids in the study area, all the bat roosting places like enclosed roosts, tents and open foliages of trees were surveyed. Various types of enclosed roosts like temples, caves, tunnels, abandoned houses, and other man-made structures in the study area were observed. The information regarding the lability of roost by bats was collected from the local peoples.

C. Diversity Indices

Varieties of indices are available to quantify biological communities. The diversity measures can be divided into 3 main categories. They are, 1) Species richness 2) Species dominance and 3) Evenness [9]. Species richness was calculated by using Margalef's index, species evenness was calculated by using Sheldon index, and species dominance was calculated by using Berger-Parker index. They were calculated by using the formulae given below,

1) Margalef's index:

Species richness measures provide an instantly comprehensible expression of diversity. It is calculated using the formula,

Dmg = (S – 1)/ In N
Where,
S = Number of species present in each taluk
N = Number of individuals

2) Berger-Parker diversity index:

Berger-Parker index is employed to determine whether there is any change in the dominance of species in each taluk. It expresses the proportional importance to the most abundant species. The formula for calculating the Berger-Parker index is
d = N max/N

Where,
N = the total number of individuals
Nmax = Number of individuals in the most abundant species.

3) Sheldon Evenness Index:
Species evenness (or Equitability) is a measure of the number of individuals with in the species population. Evenness is greatest when species are equally abundant. It is calculated by using the formula

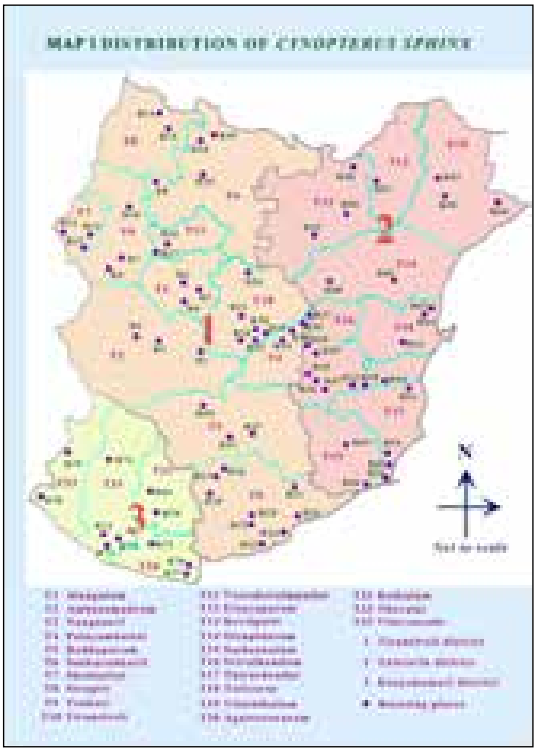
E = H'/S
`Where,
H' = the value of Shannon index
The formula for calculating the Shannon diversity index is,
H' = - å pi In pi
Where,
Pi = the proportional abundance of the ith species (ni / N)
S = Total no of individuals in each taluk.

RESULTS
Study on distribution of megachiropteran bats in the plains of Tirunelveli, Tuticorin, and Kanyakumari districts of southern Tamilnadu, south India revealed that three species of megachiropterans were found to present namely Cynopterus sphinx, Rousettus leschenaulti and Pteropus giganteus.

Distribution of Cynopterus sphinx
Distribution of C. sphinx in Tiruneveli district
In Tirunelveli district, C.sphinx was observed in 42 places in 11 taluks (Map 1). In Ambasamudram taluk 12 bat roosting tents were observed in 3 places with a total of 48 individuals of C. sphinx. In Alankulam taluk 17 bat roosting tents were identified in 3 places with a total of 40 individuals. In Tenkasi taluk 26 bat roosting tents were identified in 4 different places with a total of 73 individuals. In Schenkottai taluk 23 bat roosting tents were identified in 3 places with a total of 61 individuals. In Sivagiri taluk 9 bat roosting tents were identified in 2 places with a total of 22 individuals. In V.K. Puthur taluk a total of 13 bat roosting tents were identified in 2 places with a total of 27 individuals. In Radhapuram taluk 30 bat roosting tents were identified in 9 places with a total of 75 individuals. In Tirunelveli taluk 69 bat roosting tents were identified in 4 places with a total of 205 individuals. In Palayamkottai taluk 52 bat roosting tents were identified in 5 places with a total of 173 individuals. In Sankarankoil taluk 16 bat roosting tents were identified in 3 places with a total of 43 individuals (Table 1).

S. No	Taluk	Place	Number of roost		Total number of individuals
			Harem	Solitary	
1	Ambasu mudram	Pudukudi	4	1	12
		Kallidaikurichi	3	1	14
		V.K. Puram	5	2	22
2	Alangulam	Alangulam	9	3	20
		Nallur	4	2	9
		Iyanthankattalai	4	1	10
3	Tenkasi	Tenkasi	6	1	17
		Puliyangudi	7	2	22
		Courtallam	8	4	26
		kadayanullur	5	1	13
4	Schenkottai	Puliyarai	8	2	22
		Schenkottai	7	1	19
		Vallam	9	3	20
5	Sivagiri	Sivagiri	5	3	10
		Rayagiri	4	1	11
6	V.K. Puthur	V.K.Puthr	7	2	15
		Surundai	6	2	15
7	Radhapuram	Thisayanvillai	5	3	10
		Vijayapathi	2	1	5
		Paramesh-warapuram	1	-	4
		Kuthankuzhi	5	2	10
		Murugananth-apuram	4	1	10
		Karisuthupudhur	2	1	4
		Ayangudi	2	1	5
		Valliyoor	3	1	10
		Panagudi	6	2	14
8	Tirunelveli	Tirunelveli	11	1	37
		Gandhinagar	20	6	53
		Kunnatur	13	3	38
		Vizhagam	22	4	67
		Pettai	6	1	18
9	Palayamkottai	Palayamkottai	23	6	93
		Pillayarkulam	2	-	5
		Thirutu	5	1	16
		Santhinagar	9	3	21
		Siavalperi	13	4	35
10	Nanguneri	Padmaneri	7	2	17
		Alwarkulam	2	1	5
		Nanguneri	4	1	9
11	Sankarankovil	Karivalam	7	2	15
		Puthur	3	1	9
		Sankarankovil	6	1	17

Distribution of C. sphinx in Tuticorin district
In Tuticorin district, C.sphinx was observed in 24 places in 8 taluks (Map 1).



In Srivaikundam taluk 44 bat roosting tents were identified in 8 places with a total of 175 individuals. In Tiruchendur taluk 17 bat roosting tents were identified in 4 different places with a total of 49 individuals. In Kovilpatti taluk 16 bat roosting tents were identified in 2 places with a total of 37 individuals. In Ettayapuram taluk 9 bat roosting tents were identified in 2 places with a total of 21 individuals. In Vilathikulam taluk 17 bat roosting tents were identified in 3 places with a total of 49 individuals. In Tuticorin taluk 21 bat roosting tents were identified in 3 different places with a total of 66 individuals. In Sathankulam taluk, 16 bat roosting tents were identified in 2 places with a total of 43 individuals. In Ottapidaram taluk 17 bat roosting tents were identified in 2 places with a total of 45 individuals of C.sphinx (Table 2).

S no	District	Taluk	Place	Number of roost		Number of Individuals
				Harem	Solitary	

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1	Tuticorin	Srivaikundam	Erratathirupathi	3	1	15
			Eral	6	2	19
			Seidunganallur	2	1	16
			Karunkulam	3	2	25
			Adichanallur	6	2	28
			Pudugudi	2	2	13
			Vallanadu	5	2	41
			Murappanadu	3	2	19
		Tiruchendur	Mukkani	5	2	21
			Kulasekerapatinam	4	1	11
			Thattarmadam	2	1	11
			Manapadu	2	-	6
		Kovilpatti	Kadampur	6	2	17
			Thuraiyoor	7	1	20
		Ettaiyapuram	Ettaiyapuram	3	2	11
			Eaaral	4	1	10
		Vilathikulam	Vilathikulam	6	2	21
			Surangudi	4	2	13
			Karisalkulam	2	1	5
		Tuticorin	Tuticorin	7	3	27
			Puthukottai	5	1	16
			Korrampallam	6	-	22
		Sathankulam	Sathankulam	7	2	25
			Sathankulam	6	1	20
		Ottapidaram	Maniyachi	7	1	19
			Ottapidaram	7	2	23
2	Kanyakumari	Thovalai	Naduvurkarai	3	2	12
			Poothapandiapuram	6	1	22
		Kalkulam	Thuclay	1	1	3
			Chellan Thiruthu	4	-	24
			Kulasekaram	5	2	24
			Vaerkilambi	1	-	2
		Agastheeswaram	Nagerkovil	8	4	50
			Kovalm	2	-	4
			Perumalpuram	2	1	8
		Villavankode	Kollencode	2	1	12
			Mangode	3	2	13

0Distribution of C. sphinx in Kanyakumari district

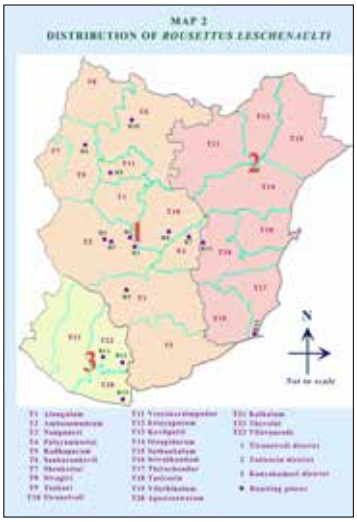
In Kanyakumari district, C.sphinx was observed in 11 places in 4 taluks (Map 1). In Thovalai taluk 12 bat roosting tents were identified in 2 different places with a total of 36 individuals. In Kalkulam taluk 14 bat roosting tents were identified in 4 places with a total of 53 individuals. In Agastheeswaram taluk 17 bat roosting tents were identified in 3 places with a total of 66 individuals and in Vilavankode taluk 8 bat roosting tents were identified in 2 places with a total of 25 individuals (Table 2).

The over all survey on distribution of C.sphinx revealed that in Tirunelveli district 280 bat roosting tents were identified in 42 different places with a total of 798 individuals of C. sphinx. In Tuticorin district a total of 157 bat roosting tents were identified in 24 places with a total of 485 individuals of C.sphinx. In Kanyakumari taluk a total of 51 bat roosting tents were identified in 11 places with a total of 180 individuals of C. sphinx.

Distribution of Rousettus leschenaulti

Distribution of R. leschenaulti in Tirunelveli district

Survey on distribution of R. leschenalti was conducted in 11 taluks of Tirunelveli district (Map 2).



The overall observation revealed that 10 roosts of R. leschenaulti was observed in 10 different places in 7 taluks. Out of the 10 roosts, 4 roosts were identified in Cheranmahadevi district, 1 roost was identified each in V. K. Puthur, Tenkasi, Palayamkottai, Tirunelveli, Nanguneri, and Sankarankovil taluks. R.leschenaulti was found to roost in temples (Plate 1) and deep wells. The colony size ranged from 3 to 1000 individuals and a total of 3957 individuals were counted in this district during the survey (Table 3).

Sno	District	Taluk	PLACE	ROOSTING PLACE	COLONY SIZE
1	Tirunelveli	Cheranmahadevi	Cheranmahadevi	Temple	1000
			Arikesavanallur	Temple	104
			Kallidaikurichi	Temple	3
			Brahmadesam	Temple	450
		V.K.Puthur	V.K.puthur	Temple	500
		Tenkasi	Thannuthu	Well	300
		Palayamkottai	Palayamkottai	Temple	100
		Tirunelveli	Town	Temple	1000
		Nanguneri	Karivelankulam	Temple	400
		Sankarankovil	Sankarankovil	Temple	100
2	Tuticorin	Srivaikundam	Vittilapuram	Temple	200
		Tiruchendur	Manapadu	Church	100
3	Kanyakumari	Thovalai	Aralvaimozhi	Cave	150
			Poothapandi	Temple	50
		Agastheeswaram	Kanyakumari	Abandoned house	70

Distribution of R. leschenaulti in Tuticorin district

Survey on distribution of R.leschenaulti was conducted in 8 taluks of Tuticorin district (Map 2). The study revealed that a total of 2 roosts were observed in 2 different places. One was found to be a church roost in Tiruchendur taluk and the other was a temple roost in Srivaikundam taluk. The colony size in temple and church roost was 100 and 200 individuals respectively (Table 3).

Distribution of R. leschenaulti in Kanyakumari district

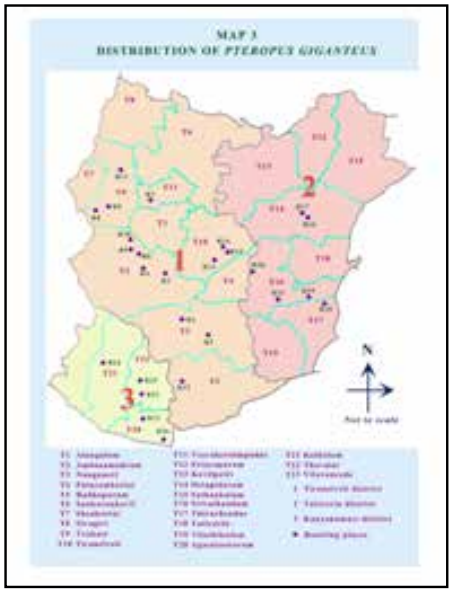
Survey on distribution of R. leschenaulti was conducted in 4 taluks of Kanyakumari district (Map 2). A total of 3 roosts were observed in 3 different places, 1 roost was in the Agastheeswaram taluk and other 2 roosts were in Thovalai taluk. A total of 270 individuals of R. leschenaulti was found to present. It uses cave, temple and abandoned house as its roost (Table 3).

Distribution of Pteropus giganteus

Distribution of P. giganteus in Tirunelveli district

The study on distribution of P. giganteus in the Tirunelveli dis-

trict revealed that it was found to roost in 15 places in 6 taluks (Map 3).



P. giganteus was found to roost in the foliages of Ficus benghalensis, Terminalia arjuna, (Plate 1) and Bassia latifolia trees. Each roosting site may comprise of one to several trees. Out of the 15 identified roosts, 4 roosts were present in Ambasamudram taluk, 3 roosts were in Nanguneri taluk, 1 roost was in V.K. Puthur taluk, 4 roosts were in Tenkasi taluk, 1 roost in Radhapuram taluk and 3 roosts in Tirunelveli taluk. Colony size ranged from 10 to 350 individuals, and a total of 4178 individuals were found (Table 4).

S. NO	DISTRICT	TALUK	PLACE	ROOSTING TREE		COLONY SIZE
				SPECIES NAME	NUMBER	
1	Tirunelveli	Nanguneri	Padmaneri	Ficus bengalensis	5	245
			Nanguneri	Terminalia arjuna	1	150
		Ambasamudram	Thirupoodaimaruthoor	Terminalia arjuna	1	35
				Bassia lattifolia	1	350
			Kallidaikurichi	Bassia lattifolia	1	10
			Sivasailam	Terminalia arjuna	4	338
			Pattamurukku	Terminalia arjuna	3	850
		V.K. Pudhur	V.K. Pudhur	Bassia lattifolia	5	700
		Tenkasi	Courtallam	Bassia lattifolia	1	250
			Kadayam	Terminalia arjuna	1	300
			Tenkasi	Terminalia arjuna	1	100
			Karuppanathi	Ficus bengalensis	1	200
		Radhapuram	Panagudi	Terminalia arjuna	1	200
		Tirunelveli	Tirunelveli-town	Ficus bengalensis	1	250
			Sankar Nagar	Ficus bengalensis	1	100
			Rajavillipuram	Terminalia arjuna	2	100
2	Tuticorin	Ottapidaram	Akilandapuram 1	Ficus bengalensis	1	100
			Akilandapuram 2	Ficus bengalensis	1	75
		Tiruchendur	Attur	Terminalia arjuna	2	450
				Ficus bengalensis	1	200
		Srivaikundam	Eral	Terminalia arjuna	1	300
			Murappanadu	Terminalia arjuna	1	400
			Srivaikundam	Terminalia arjuna	30	15425
3	Kanyakumari	Thovalai	Poothapandiapuram	Bassia lattifolia	4	730
				Tamarindus indicus	1	75
		Vilavancodu	Kuzhithurai	Ficus bengalensis	1	250
		Agastheeswarm	Idalankudi	Ficus religiosa	1	75
		Kalkulam	Kulasekaram	Ficus bengalensis	1	75
				Terminalia arjuna	1	30
		Thovalai	Puliyankulam	Ficus bengalensis	1	75
			Kanyakumari	Terminalia arjuna	1	100

Distribution of P. giganteus in Tuticorin district

In Tuticorin district 6 roosts were identified in 3 taluks (Map 3). 2 roosts were identified in Ottapidaram taluk, 1 roost was in Tiruchendur taluk, and 3 roosts were in Srivaikundam taluk. The bats were found to roost in the trees of Ficus bengalensis and Terminalia arjuna. Colony size ranged from 75 to 1200 individuals and a total of 16950 individuals were found (Table 4).

Distribution of P. giganteus in Kanyakumari district

In Kanyakumari district a total of 6 roosts were identified in 4 taluks (Map 3). 3 roosts were identified in Agastheeswaram taluk, 1 roost each in Thovalai, Vilavancode and Kalkulam taluk respectively. The bats were found to roost in the trees of Bassia latifolia, Ficus benghalensis, F. religiosa, Terminalia arjuna and Tamarindus indica, Colony size ranges from 10 to 250 individuals and a total of 1410 individuals were found (Table 4).

Diversity measures of pteropodid bats

The study on diversity measures of pteropodid bats in Tirunelveli, Tuticorin and Kanyakumari districts revealed that, the greatest degree of C. sphinx richness (Dmg = 1.497) and dominance (d = 0.257) was observed at Tirunelveli district and evenness (E2 = 0.94) at Kanyakumari district. The greatest degree of richness of R. leschenaulti (Dmg = 0.724) and dominance (d=0.393) was observed at Tirunelveli district and the greater degree of evenness (E2 = 0.945) at Tuticorin district. The greatest degree of richness (Dmg = 0.609), evenness (E2 = 0.818) and dominance (d = 0.383) of P. giganteus was observed at Tirunelveli district (Table 5 a, b, c).

a) TIRUNELVELI DISTRICT

S.NO	SPECIES	DIVERSITY MEASURES		
		D_{mg}	d	E2
1	C. sphinx	1.497	0.257	0.768
2	R. leschenaulti	0.724	0.393	0.70
3	P. giganteus	0.601	0.383	0.818

b) TUTICORIN DISTRICT

S.NO	SPECIES	DIVERSITY MEASURES		
		D_{mg}	d	E2
1	C. sphinx	1.132	0.341	0.811
2	R. leschenaulti	0.175	0.607	0.945
3	P. giganteus	0.206	0.980	0.595

c) KANYAKUMARI DISTRICT

S.NO	SPECIES	DIVERSITY MEASURES		
		D_{mg}	d	E2
1	C. sphinx	0.378	0.367	0.94
2	R. leschenaulti	0.179	0.741	0.886
3	P. giganteus	0.404	0.371	0.771

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Discussion

The study on the distribution of megachiropteran bats in the plains of Tirunelveli, Kanyakumari and Tuticorin districts of Tamilnadu, South India revealed that three species of bats were present in all the three districts namely, C. sphinx, R. leschenaulti and P. giganteus.

C. sphinx was found to be present at a higher rate at the Tirunelveli districts compare to the other two, is mainly due to the presence of sumptuous foraging and roost resources. The availability of the ideal roost and food resources favours the distributional status of bats[5]. C. sphinx prefers to roost at a higher rate in the urban areas, with human settlements. It may be mainly due to the presence of food and roost resources, as people may grow curtain creepers, mast trees and palms which provide roosts and grow fruiting trees like guava, sapota and mango etc which provide food sources [6].

Survey of R. leschenaulti revealed that, it was observed to roost in the temples, church belfry, caves and in wells. R. leschenaulti was reported to had a gregarious roosting behaviour [10, 11] and colonies consisting of ten to thousand individuals was identified. R. leschenaulti was observed to roost mostly in the temple roosts in all the three districts. Temples provide ideal roosting sites for R. leschenaulti with low temperature, high humidity, dim lighted chambers, undisturbed places and as most of the chambers in the temple roost are larger in size it enable and facilitate them to fly from one chamber to another, temple roost provides all such conditions compare to the other types of enclosed roost. Temperature and humidity and other physiological and biological parameters observed to play a vital role in the roosting habits of bats in cave and other man made structures [5, 12].

On considering the distribution of P. giganteus, bats in the genus Pteropus are characterized as requiring a variety of geographic and ecological habitat characteristics [13,14]. Most of the roosting sites of P. giganteus were observed to nearer to the water bodies, 19 roosts were observed to be on the banks of river Thamirabarani [8]. P. scapulatus and P. gouldi in Australia occurred along the river banks or water holes and occasional in open forests [15].

Study on the diversity measures shows that there is a greater variation in the diversity and richness of megachiropteran bats in these three districts. A greater species richness was observed in Tirunelveli district, this area provides sumptuous amount of food sources and roost resources for bats, it also had a diverse habitat structure from riverside to urban human settlements, hence it exemplifies a greater degree of species richness and diversity. The topography of the districts also reveals such a factor, it is on the perennial Thamirabarani River and surrounded by agricultural lands, orchards and numerous wild varieties of bat feeding fruits were also observed to prevail in this district. Apart from this, the area also holds a rich distribution of microchiropteran bats; a total of 11 species of microchiropteran bats was identified in this district [7].

Habitat destruction is the major threats for bats, which culls the entire bat population in an area. In the study area Tirunelveli district C. sphinx was observed to construct tents in the curtain creeper [6], but during our survey we couldn't observe any such tent roost in this part, all such roost had been damaged. Population status of C. sphinx [16]and R. leschenaulti [12] in this region, but with in this quinquinum the population of both the bat species deteriorated to half of its actually reported mainly due to habitat destruction. The temple renovation, disturbance of roosting site of R. leschenaulti and devastation of roosting tree tents of C. sphinx was the main factors for such decrease. Apart from this P. giganteus was hunted because of the falsehood among the peoples that its' flesh has got the ability to cure asthma. Hunting for flesh [17] and sport was observed to be the major cause of decline in P. giganteus population. A greater decline in the population of P. tonganus in Niue island was mainly due to over hunting [18]. The loss of extensive areas of foraging and roosting habitat may also be responsible for the flying fox to shift its regular sites [19] and preventing of such discriminancies that cull bats would enrich the population of this wonderful creature in this part.

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