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Caption: Stripe-backed Weasel Mustela strigidorsa. Medium-digital, Software-procreate, Device-iPad + Apple pencil © Dhanush Shetty.

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## Roosting habits and habitats of the Indian Flying Fox Pteropus medius Temminck, 1825 in the northern districts of Tamil Nadu, India

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Abstract: This paper pertains to the study on roosting habits and habitats of the Indian Flying Fox Pteropus medius Temminck, 1825 in 12 villages of four northern districts-Vellore, Krishnagiri, Tiruvannamalai, and Viluppuram-of Tamil Nadu. Studies targeted roosting tree species, population status, diurnal-roosting behaviour, interactions with other animals, and probable threats to the species. A total of 22,365 individuals of the species were observed in 72 roosting colonies in 72 trees belonging to nine families, 11 genera, and 13 species. The tree species that harbored the greatest population of P. medius (n= 12,465) were those of Tamarindus indica L. (Fabaceae) (n= 39), followed by Ficus religiosa L. (Moraceae) (n= 3.960), Madhuca latifolia J.F. Macbr. (Sapotaceae) (n= 2.760), and Ficus benahalensis L. (Moraceae) (n= 1,620). One-Way ANOVA revealed that a significant relationship exists between colony size and tree diameter at breast height (dbh), and their canopy size (p < 0.05). However, no significant difference occurred between the colony size and tree height. The time taken for emergence of individuals of the colony from the canopy for foraging varied between 20 and 40 min after 1750 h in the evening. The species mostly roosted on trees proximal to human settlements, electrical power lines, and water bodies. Individuals of P. medius used various tree species in different areas in different geographical regions and did not maintain any consistency in roosting tree species selection. A majority of individuals (88.7 %; n= 887) were found roosting using both legs and a minority of P. medius (11.3 %; n= 113) were clinging to tree branches using one. Individuals of *P. medius* flew to nearby water bodies to quench thirst and cool their bodies. Mating was observed during day roost in 146 pairs including male-female fellatio in seven pairs. Smoke from shrines in sacred groves, pruning of branches for various cultural reasons, populations of House Crow Corvus splendens (Vieillot, 1817) (Corvidae), Black-winged Kite Elanus caeruleus (Desfontaines, 1789) and Black Kite Milvus migrans (Boddaert, 1783) (both Accipitridae) were key disturbances to roosting populations of P. medius.

Keywords: Diurnal behaviours fellatio, mating, Pteropus giganteus, roosting trees, threats.

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Author contributions: MP has conceptualized, designed the research, performed survey, wrote paper, reviewed and edited the paper for final approval. SS has analysed the data and gave interpretations.

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## INTRODUCTION

1

The order Chiroptera consists of over 1,400 species of bats worldwide, of which 148 species occur in southern Asia (Simmons & Cirranello 2020; Srinivasulu et al. 2021a). Pteropodidae, the Old-World fruit-eating bats, are well adapted to live in the tropics, particularly in India, Bangladesh, Bhutan, Nepal, China, the Maldives, Myanmar, Pakistan, and Sri Lanka (Helgen et al. 2009; Jnawali et al. 2011). India harbors 12 species of fruit bats and among them three occur commonly; they include Pteropus medius, P. leschenaultii, and Cynopterus sphinx (Srinivasulu et al. 2021b). The Indian Flying Fox Pteropus medius Temminck, 1825 (earlier treated as P. giganteus) is one of the largest bats and is widely distributed in southern and south eastern Asia (Marimuthu 1996). This species is a gregarious, colonial mammal that roosts in large trees that possibly protect them from strong winds and offer an easy updrift access for flight. The number of individuals of P. medius per colony was found to be varied. Between 260 and 1,550 individuals were recorded during different months (January-October) in a single colony in the Kathmandu valley, Nepal (Manandhar et al. 2018), whereas a colony of 2,844 individuals was recorded in the Lower Dir district, Pakistan (Khan et al. 2021). A total of 11,000 individuals were counted on 182 trees in Jambughoda Wildlife Sanctuary, Gujarat (Vyas & Upadhyay 2014). An average of 43 to 6,141 individuals was counted in the colonies on 19 tree species in Odisha (Rao & Poyyamoli 2017). In Tamil Nadu, over 600 individuals in Nallur near Chennai (Smith 1998), 16,000 individuals in Srivaikundam (Sudhakaran et al. 2010), and 431 individuals in Pudukottai district were enumerated. They usually prefer to roost on tall trees in urban areas of Lahore, Pakistan (Gulraiz 2014). In Tamil Nadu, they preferred Terminalia arjuna trees in Srivaikundam (Sudhakaran et al. 2010) whereas Vachellia leucophloea (= Acacia leucophloea) and Pongamia pinnata in Pudukottai district (Tangavelou et al. 2013)

Generally, bat roosting sites are found adjacent to water bodies (Fenton & Barclay 1980; Kunz 1982; Thomas 1988). The colonies of *P. medius* mostly preferred to choose trees for roosting near human settlements in India and Nepal (Bates & Harrison 1997; Katuwal et al. 2019). They exhibit various diurnal behaviour during day roost and belly-soaking behaviour is very common among this species during summer in Purulia district of West Bengal probably to regulate body temperatures (Dey et al. 2015). This species utilizes rain water droplets to quench its thirst by licking rain droplets from its patagium (Baskaran et al. 2016). The majority of individuals cling to the branches using either both legs or with single leg (Rao & Poyyamozhi 2017). Mating in the day roost and fellatio behaviour in heterosexual pairs was common among bats (Wilkinson 1986; Kerth et al. 2003; Tan et al. 2009), and so in *P. medius* individuals (Maruthupandian & Marimuthu 2013). The emergence time of *P. medius* individuals from the roosting trees varied: early emergence occurred during winter (1720–1837 h) and delayed emergence during summer (1838–1946 h) in Mohanlal Ganj, Uttar Pradesh (Ramkumar et al. 2019).

Populations of flying foxes are declining worldwide (Mildenstein et al. 2005; Stier & Mildenstein 2005) due to growing human population, destruction of habitats by felling of trees (Chakravarthy & Yeshwanth 2008), hunting by humans (Marimuthu 1996), shortage of their food resources, and urbanization (Fujita & Tuttle 1991; Mickleburgh et al. 2002). Deforestation, electrocution, expansion of highways, construction of buildings, and hunting reduces populations of P. medius (Molur et al. 2008; Ali 2010). A variety of birds of prey and various reptiles including snakes and lizards prey upon bats (Pierson & Rainey 1992). Ethnic communities usually hunt the Indian Flying Fox for meat as they believe it to have medicinal value (Acharya 2008; Thapa 2008). Various conservation attempts have been made for tree roosting P. medius (Katuwal et al. 2019). The IUCN Red List of Threatened Species categorises conservation status of this species as 'Least Concern' (Tsang 2020). No detailed studies were carried out on the habits and habitats of P. medius in the northern parts of Tamil Nadu. Hence to fill up this gap the present study was carried out.

This study, focussing on how habitat disturbances will affect the populations of P. medius, will contribute to future studies on the role of habitat disturbances on species in southern India. In this study, we aimed to document the diurnal roosting behaviour of P. medius with special reference to trees utilized in northern Tamil Nadu. The following objectives were targeted: (1) to assess the population status of P. medius and roosting tree species in the study area; (2) to understand the relationship between the roosting sites of P. medius and distances from human settlements, electric power lines, water bodies, and mobile-phone towers; (3) to document diurnal behaviours including mating and preemergence patterns; (4) to know interaction with other animals; and (5) to access the probable threats to their populations.

## MATERIALS AND METHODS

## STUDY AREA

The study was carried out in 12 villages (listed in the legend of Figure 1) located in Krishnagiri, Vellore, Tiruvannamalai, and Viluppuram districts of northern Tamil Nadu (c. 17,000 km<sup>2</sup>, c. 80,40,000 human population). Agriculture is the principal occupation of the residents. The maximum and minimum annual temperatures in these districts are 36 °C and 20 °C, respectively. The average annual rainfall is 1,060 mm (www.tn.gov.in).

## **METHODS**

We selected 72 active roosting colonies of *P. medius* distributed on 72 trees belonging to 13 species in 12 villages where *P. medius* populations were known to be locally present through nomadic gypsies. The number of *P. medius* observed on each tree was considered a single roost/colony. The roosting colonies and trees were surveyed between 0600 and 1900 h from June 2020 to January 2021.

**Questionnaire study:** Eighty respondents, all above 60 years old, residing adjacent to the roosting sites were interviewed as they have information from the past, in



Figure 1. Study area: A—India map showing Tamil Nadu | B—Tamil Nadu indicating four study districts | C—Names of the 12 villages: 1. Kazhuperumbakkam, 2. Anumandai, 3. Maruvur, 4. Padhiri, 5. Rayandapuram, 6. Kesavapuram, 7. Vandavasi, 8. Marudhadu, 9. Gudiyatham, 10. Ongapadi, 11. Chenur, and 12. Junjupalli.

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the selected 12 villages using a questionnaire survey form (in the Tamil language). The questionnaire form included questions on time periods of existence of the local *P. medius* colonies, population trends, details on roosting trees and tree selection, persecution and hunting of the flying fox, and perception of the local community about the animal as a nuisance, and the probable threats to the populations of local *P. medius* colonies.

**Population count:** A population count of the selected *P. medius* colonies was carried out visually and by using a pair of Super Zenith field binoculars (Model No. 20 x 50 Field 3°, Jack Berg, El Paso, Texas, USA) following Barlow's (1999) direct roost-count method. The count was conducted fortnightly during June–July 2020 and the numbers were arithmetically averaged.

Behavioural study: Some behaviours of the species in the colonies such as grooming, mating, and interactions with other animals were also observed. Anthropogenic impacts such as smoke from cooking, hunting, and pruning of trees chosen for roosting were observed and the level of impact was categorized. The height was measured using Silva Clinometer (Gulraiz 2014), dbh (diameter at breast height), canopy width and distance between roosting trees were measured using 100 m measuring tape. The nearest human settlements, power lines, water bodies, and mobile-phone towers were measured using a 100 m measuring tape. The canopy width was obtained by cross method (Blozan 2006) by measuring the edge of the canopy shadow on the ground. The pre-emergence and emergence activities were observed between 1700 and 1900 h for 20 days in January 2021. Locations of the colonies and mobilephone towers were determined using a standard GPS (Garmin Etrex 20x, 2017, Garmin Corporation, Taiwan). Photographs and videography were made using a digital camera (Nikon Coolpix P1000 Super-telephoto, Nikon).

## DATA ANALYSIS

One-way analysis of variance (ANOVA) was used to test the difference in means between the numbers of *P. medius* counted and the types of roosting tree species by using Statistical Package for Social Science (SPSS version 25.0 software). Roosting tree species having more than two individuals were considered for analysis. Those tree species with less than two individuals were ignored. Oneway ANOVA was used to test the significance between the numbers of individuals of *P. medius* counted and the height, dbh, and canopy size of roosting trees. Test of significance between the variables was assessed at p <0.05.

## RESULTS

## Tree species selection for roosting

A total of 22,365 individuals of P. medius were counted from 72 colonies (Table 1). The roosting sites occurred in and around 11 human settlements, 11 sites in farmlands, and five sites near shrines within sacred groves. Out of the 12 villages, the maximum individuals that is 32.64 % (n= 7,298) occurred in Ongapadi (Vellore district) and the least 1.77 % (n= 398) in Junjupalli (Krishnagiri district). Among four districts, the highest population of P. medius (n= 9,268; 41.45 %) occurred at Vellore district on 10 trees, followed by 23.68 % (n= 5,298) on 47 trees in Tiruvannamalai district, and 20.91 % (n= 4,678) on seven trees in Krishnagiri district. The least populations of 13.95 % (n= 3,121) were counted on eight trees in Viluppuram district. On an average, 310 individuals of P. medius /tree existed in the study area. (Table 1, Image 1).

Altogether, 13 species belonging to 11 genera and nine families of 72 trees were roosted upon by *P. medius.* Bambusa arundinacea (L.) Voss (Poaceae), a large, arborescent herb, was one among the 13 species. A total of 12,465 individuals (55.73 %) of *P. medius* lived on 49 trees of the family Fabaceae. Most of the colonies (53.9 % of their total population, n= 12,055) were on *Tamarindus indica* L. (n= 39) and a minimum population (0.12%, n= 28) on a single *Lannea coromandelica* (Houtt.) Merr. (Table 2).

The tree species used for roosting, such as *Delonix* regia (Boj. ex Hook.) Raf., Azadirachta indicaA. Juss., Ceiba speciosa (A.St.Hil.) Ravenna, Lannea coromandelica (Houtt.) Merr., Madhuca longifolia J.F.Macbr., Syzygium cumini (L.) Skeels., and Terminalia arjuna L. were represented only by either one or two trees which were excluded from the analysis. Statistical testing (ANOVA) revealed a significant relationship between the means of *P. medius* individuals and the tree species chosen by *P. medius* for roosting ( $F_{5.56}$ = 5.35, p <0.05).

One-way ANOVA shows the relationship between the height, dbh, and canopy size of the roosting trees. However, no significant relationship occurred between the average number of *P. medius* and heights of the trees ( $F_{2,69}$ = 1.42, p >0.05). Nevertheless, there was a significant difference between the average number of *P. medius* and the dbh of trees used by *P. medius* for roosting ( $F_{2,69}$ = 8.25, p <0.05). In addition, significant differences occurred between the number of *P. medius* and the canopy size of roosting trees ( $F_{2,69}$ = 10.34, p <0.05).

Pandian & Suresh

Table 1. District-wise details of villages, G	PS co-ordinates, number o	f roosting trees and total i	number of Pteropus medi	us counted in the study
area.				

	District	Name of the village	GPS	Total no. of trees have roosting colony	Total no. of <i>P.</i> <i>medius</i> counted on these trees	Percentage (%) of <i>P. medius</i>
1		Gudiyatham	12.938438°N, 78.861062°E	4	1970	8.8
2	vellore	Ongapadi	12.822734°N, 78.946628°E	6	7298	32.63
3	Krishnagiri	Junjupalli	12.564656°N, 78.164119°E	4	398	1.64
4		Chenur	12.360311°N, 78.583989°E	3	4280	19.13
5	 Tiruvannamalai	Rayandapuram	12.092188°N, 78.928710°E	13	2723	12.17
6		Kesavapuram	12.655683°N, 79.126282°E	18	1417	6.33
7		Vandavasi	12.510984°N, 79.597503°E	10	700	3.12
8		Marudhadu	12.490742°N, 79.653357°E	6	458	2.94
9	Viluppuram	Kazhuperumpakkam	12.067317°N, 79.829502°E	1	780	3.48
10		Anumandhai	12.131800°N, 79.911418°E	4	1251	5.59
11		Maruvur	12.164664°N, 79.515650°E	1	410	1.83
12		Padhiri	12.314802°N, 79.755639°E	2	680	3.04
Total	4	12		72	22365	100

## Table 2. Details on the diversity of roosting trees and total *Pteropus medius* counted in the study area.

	Type of roosting trees	Family	Total no. of trees have <i>P.</i> <i>medius</i> roosting	Total no. of <i>P. medius</i> individuals counted
1	Albizia lebbeck (L.) Benth.	Fabaceae	5	219
2	<i>Dellonix regia</i> (Boj. ex Hook.) Raf.	Fabaceae	1	120
3	Pongamia pinnata (L.) Panigrahi	Fabaceae	4	71
4	Tamarindus indica L.	Fabaceae	39	12055
5	Azadirachta indica A.Juss.	Meliaceae	1	46
6	Bambusa arundinacea (L.) Voss	Poaceae	7	468
7	Ceiba speciosa (A.St.Hil.) Ravenna	Malvaceae	2	175
8	Ficus benghalensis L.	Moraceae	4	1620
9	Ficus religiosa L.	Moraceae	3	3960
10	Lannea coromandelica (Houtt.) Merr.	Anacardiaceae	1	28
11	<i>Madhuca longifolia</i> J.F.Macbr.	Sapotaceae	1	2760
12	<i>Syzygium cumini</i> (L.) Skeels.	Myrtaceae	2	56
13	<i>Terminalia arjuna</i> (Roxb.) Wight & Arn.	Combretaceae	2	787
	Total	9	72	22365

# Apparent preference of trees close to human settlements

Sixty per cent of the trees used for roosting (n= 43) and 80 % individuals of total population of *P. medius* 

(n= 17,880) occurred within 100 m radius from human settlements. No roosting trees were located between 100 and 250 m. Only 40 % trees used for roosting (n= 29) and 20 % individuals (n= 4,485) of *P. medius* were found beyond 250 m (Figure 2).

Forty-three per cent of trees used for roosting (n= 31) and 64.75 % of *P. medius* (n= 14,482) occurred within a 25-m radius from electric power lines. A maximum of 84.72 % of trees used for roosting and 92.1 % *P. medius* (n= 20,600) occurred within a 100-m radius from power lines. Only 15.28 % of trees used for roosting (n= 61) and 7.9 % of *P. medius* (n= 1,765) occurred beyond 100 m. No mortality of *P. medius* due to electrocution was noticed during the study period (Figure 3).

Ninety-six per cent of trees used for roosting (n= 69) and 80.86 % of *P. medius* (n= 18,085) occurred within 1,000-m radius from water bodies such as lakes, ponds, rivers, and canals (Figure 4). Thirty-two per-cent of trees used for roosting (n= 23) and 50.4 % P. medius individuals (n= 11,272) occurred within a 500-m radius from mobile-phone towers and 62.5 % trees (n= 45) and 28.62 % *P. medius* (n= 6,403) were observed within a 501–2000 m radius from mobile-phone towers. The remaining 5.55 % trees (n= 4) and 20.97 % *P. medius* (n= 4,690) occurred beyond 2001 m from mobile-phone towers (Figure 5).

## Perception of local people

Of the 80 local respondents interviewed, 87 % residents (n= 66) were concerned over the declining populations of *P. medius* and the numbers of trees

1

Pandian & Suresh



Image 1. Roosting habitats of *Pteropus medius*: a & b—Roosting habitats in sacred groves | c & d—Roosting in *Tamarindus indica* tree | e— Male in *Ficus benghalensis* tree | f—Female in *Ficus benghalensis* tree | g—Power cables passing adjacent to roosting tree *Tamarindus indica* | h—Roosting *Bambusa arundinacea* bush near water body. © M. Pandian

used for roosting. That the residents of these villages consider roosting populations of flying foxes important in their culture and life is notable. For example, if they considered it a bad omen, they would have either cut those trees that accommodate roosting populations of P. medius or chased the roosting colonies away from the trees. However, in Junjupalli village, we observed that soon after a marriage ceremony, the married couple worshipped the tree (Ficus benghalesnsis) supporting a roosting population of P. medius. Residents from the villages reported that the numbers of P. medius had reduced, compared to six decades ago. Thirtyfive residents (44 %) indicated either occasional or clandestine hunting of P. medius for folk-medicinal reasons. Seventy-four residents (92 %) considered the presence of a roosting colony as a sign of prosperity to their village. Sixty residents (75 %) indicated that cracker bursting was always done only after sunset when P. medius population was away from the trees for foraging. To protect roosting colonies of P. medius residents of Ongapadi village avoided bursting crackers during festive times. Seventy-four residents (92 %) considered P. medius populations within the village were never a nuisance; despite the fact that these animals desecrate houses, walls, and other common public areas under the roosting trees, and the foul odour emanating from the droppings. Sacredness and an environmental value addition because of culture, offer 'protection' to populations of P. medius contributing to their conservation.

### Behaviour of P. medius

During the north-east monsoon rains (October— November 2020), individuals of *P. medius* were observed clinging to tree branches with their heads and ventral parts of their body wrapped with their membranous wings. Immediately after the rain, they flap their wings speedily and move from one branch to another. After the rain, they groom, scratch, and lick water droplets from their body (Image 2).

During hot summer days (June—July), individuals of *P. medius* moved from the top of the canopy downwards, i.e., midparts of the tree and roosted on large tree trunks, probably to avoid direct exposure to sunlight. In June–July 2020 in Marudhadu village, five incidents of *P. medius* individuals flying to a nearby lake and soaking the ventral part of their body were observed.

## Mating

One-hundred-and-forty-six incidents of mating were observed in the studied villages between 0700 h and



Figure 2. Bar-chart showing the distance between roosting of *Pteropus medius* and human dwellings in the study area.



Figure 3. Bar-chart showing the distance between roosting of *Pteropus medius* and power cables in the study area.



Figure 4. Bar-chart showing the distance between roosting of *Pteropus medius* and waterbodies in the study area.



Figure 5. Bar-chart showing the distance between roosting of *Pteropus medius* andmobile-phone towers in the study area.

1645 h during October—December 2020. A maximum of 26 pairs engaged in courtship and copulation was observed in Kesavapuram village, and two mating pairs in Anumandhai village. Before copulation, seven incidents of males licking the genitalia of the females

Pandian & Suresh

#### Pandian & Suresh



Image 2. Roosting habits of *Pteropus medius*: a—Individuals hanging with one and two legs | b—Fighting individuals | c—Roosting tree close to residence | d—Covering the body with patagium-ventral view | e—Covering the body with patagium-dorsal view | f—Covering the body with patagium-during rain. © M. Pandian

were observed, which occurred for 2—4.5 min. After copulation, both pairs moved away from each other and female–male fellatio stopped. Two instances of males licking their own penises before copulation were observed in Padhiri village (Table 3; Image 3).

## **Emergence from trees**

A total of 20 pre-emergence and emergence

activities were observed for 20 days continuously from 1700 to 1900 h in Kazhuperumbakkam and Maruvur (Viluppuram district). Frequent and irregular migrations of individuals from one branch to another either in the same tree or between different trees occurred between 1710 and 1750 h. From a minimum of one to a maximum of 11 were found flying, encircling the canopy for a few minutes and returning to the tree used for roosting.



Image 3. Roosting habits of *Pteropus medius*: a & b—*Pteropus medius* individuals migrate to tree trunk to avoid exposure to direct sunlight | c—Individual with punctured patagium | d—Female-male fellatio | e—Copulation | f—Desecration of residence due to excreta of roosting individuals | g & h—Pruned roosting trees. © M. Pandian



Image 4. Pictures showing threats to *Pteropus medius*: a—Monkey chases roosting *P. medius* individuals | b—Monkey slaps a *P. medius* | c— House Crow disturbs roosting colony | d—Black-winged Kite near roosting colony. © M. Pandian

Wing flapping and grooming activities were high and almost all individuals of *P. medius* concurrently made vocal communications, resulting in a loud, collective noise around the roost. The emergence of the first batch of individuals (10–50) from the colony occurred between 1750 and 1810 h. The emergence time of the last batch of the colony was between 1820 and 1840 h. The time taken for emergence of individuals (80–100) of the colony from the canopy varied between 20 and 40 min.

## Interactions with other animals

Twelve incidents of *Macaca radiata* (E. Geoffroy, 1812) (Cercopithecidae) living on *T. indica* trees in Gudiyatham and Rayandapuramwere observed. When a troop of *M. radiata* climbed over *T. indica* trees to feed on flowers and raw fruits, *P. medius* individuals from the nearby branches flew away from these trees to nearby trees. In one instance, one *M. radiata* was found slapping a roosting *P. medius* when the latter hindered it while plucking fruits of *T. indica. Corvus splendens* frequently visited the trees used by *P. medius* for roosting, disturbing

them. When the *P. medius* started to fly, *C. splendens* selectively chased the juveniles of *P. medius* away. A total of 36 incidents of *C. splendens* chasing *P. medius* individuals from roosting colonies were observed. But no incidents of *C. splendens* predating on the juveniles of *P. medius* were found during the study (Fig 10).

## Threats

Smoke disturbance to roosting colonies of *P. medius* was common around shrines located within sacred groves. Local residents cook porridge on firewood stoves to offer to deities in the sacred groves in Marudhadu, Kazhuperumpakkam, Padhiri, Maruvur, and Chenur during July–August and January–February. The emerging smoke disturbed *P. medius* individuals, driving them away from the trees to migrate to other trees (e.g., *T. indica* and *F. religiosa*) situated outside the villages for roosting.

Trees chosen for roosting by *P. medius* adjacent to residential areas and farm lands are frequently pruned because the village administrators see them as obstructions to electric power lines and villagers who see

 Table 3. Details of mating pairs and female-male fellatio observed

 during day roost in October and December 2020 in the study area.

	District	Name of the village	Total no. of mating individuals observed	Female- male fellatio observed
1	) /- II	Gudiyatham	12	2
2	vellore	Ongapadi	08	0
3		Junjupalli	14	0
4	Krisnnagiri	Chenur	04	1
5	- Tiruvannamalai	Rayandapuram	22	0
6		Kesavapuram	26	2
7		Vandavasi	08	0
8		Marudhadu	14	0
9		Kazhuperumpakkam	20	1
10	- Viluppuram	Anumandhai	02	0
11		Maruvur	06	0
12		Padhiri	12	1
Total	4	12	146	7

them preventing sunlight to crop plants. One *P. medius* individual was noticed with a damage on its patagium. Although the exact cause for the damage was unknown. One Black-winged Kite *Elanus caeruleus* (Desfontaines, 1789) was seen hovering and roosting on power lines in the vicinity of trees used by *P. medius* for day roost at Maruvur village, although no incident of attack by *E. caeruleus* on *P. medius* was observed. Villagers remarked that Black Kites, Black-winged Kites, and House Crows occasionally predate on the juveniles of *P. medius*.

## DISCUSSION

## Tree species selection for roosting

The Indian Flying Fox has been known to use nine tree species in avenues in Delhi (Mishra 2010) and 18 tree species in Uttar Pradesh (Kumar et al. 2017). In the present study conducted in Vellore, Krishnagiri, Tiruvannamalai, and Viluppuram districts in northern Tamil Nadu, *P. medius* populations used 13 tree species belonging to nine families and 11 genera for roosting. Among the 13 species of roosting trees, *T. indica* and *L. coromandelica* are the most preferred by the flying fox in Tamil Nadu. The same taxa also commonly occur in Vellore, Krishnagiri, Tiruvannamalai, and Viluppuram districts, except *H. brasiliensis* (Vijayasankar et al. 2012) but these tree species were not selected by *P. medius* populations for roosting. Tree species such as *P. longifolia*, *Neolamarckia cadamba* (Roxb.) Bosser. (Rubiaceae), Eucalyptus citriodora (Hook.) K.D.Hill & L.A.S. Johnson (Myrtaceae), Mimusops elengi L. (Sapotaceae), Samaneae saman (Jacq.) Merr. (Fabaceae), Tectona grandis L.f. (Lamiaceae), Peltophorum pterocarpum (DC.) K.Heyne, and Lagerstroemia speciosa (L.) Pers. (Lythraceae) (Rao & Poyyamoli 2017) were not used by P. medius in Vellore, Krishnagiri, Tiruvannamalai, and Viluppuram disricts. In Pudukkottai district, central Tamil Nadu, P. pinnata and V. leucophloea, especially in the sacred groves, were the trees used maximally for roosting (Tangavelou et al. 2013). In the present study, P. pinnata was the tree that housed maximum roosting populations of P. medius (n= 71). Different species of Eucalyptus (Myratceae) were the most used trees for roosting in Kathmandu (Nepal) (Manandhar et al. 2018). But in the present study area no Eucalyptus tree species was used by P. medius for roosting, although various species of Eucalyptus occur abundantly in the studied districts. The reason may be due to the felling of Eucalyptus trees periodically by the social forestry department because these trees were not allowed grow for long periods and hence, P. medius might have avoided selecting this tree species. These findings indicate that P. medius use various tree species in different geographical regions and do not maintain any consistency in tree selection for roosting.

No positive relationship occurred between the numbers of P. medius and heights of the trees used for roosting (F<sub>2.69</sub>= 1.42, p >0.05). Significant relationship existed between the dbh and canopy size of trees selected for roosting and the number of P. medius individuals in urban and semi-urban areas in Uttar Pradesh (Kumar & Elangovan 2019). In the present study, a significant, positive relationship occurred between the means of P. medius individuals and numbers of A. lebbeck, P. pinnata, T. indica, B. arundinacea, F. benghalensis, and *F. religiosa* chosen by *P. medius* for roosting ( $F_{5.56}$ = 5.35, p <0.05). There was a significant difference between the average number of *P. medius* and the dbh ( $F_{2.69}$ = 8.25, p <0.05) and the canopy size of trees used by P. medius for roosting ( $F_{2.69}$ = 10.34, p <0.05). It indicates that individuals of P. medius preferred trees with larger dbh and larger canopy size for roosting in the study area.

## Apparent preference of trees close to human dwellings

In the Indian subcontinent, populations of *P. medius* mostly preferred to choose trees for roosting near human settlements (Bates & Harrison 1997). In lower Nepal, most of the colonies of *P.* medius were recorded close to human settlements and in farmlands (Katuwal et al. 2019). This species roosts on trees that occur close to human settlements in Tirunelveli district, viz., sacred

groves, and agricultural lands (Jayapraba 2016). In the present study, 60 % of trees (n= 43) chosen for roosting and 80 % *P. medius* individuals (n= 17,880) were found within 100 m radius from human settlements and hence it is in accordance with the observations of Bates & Harrison (1997), and Katuwal et al. (2019).

## **Behaviours observed**

In New South Wales, Australia, flying foxes were observed to visit nearby water bodies in peak summers to soak their fur and wings to cool their bodies (Welbergen et al. 2008). Belly-soaking behaviour is very common among the Indian Flying Fox during summer in Purulia district of West Bengal (Dey et al. 2015). In the present study, the observations of partial dipping of its ventral body surfaces in water might have been to quench its thirst and to reduce its body temperatures during hot summer and hence it matches with the views of Dey et al. (2015) and Welbergen et al. (2008).

Populations of *P. medius* usually roost on trees for 12–14 h daily hanging from branches. A majority of individuals (88.7 %) were found roosting using both legs and a minority of *P. medius* (11.3 %) were clinging to tree branches using one. They probably relax their leg muscles by alternately using both or a single leg and it requires further studies. The majority of individuals clinging to the branches used both legs during day roost as stated by Rao & Poyyamozhi (2017).

After rainfall the individuals of *P. medius*, groom, scratch, and lick their body to remove the water droplets (Maruthapandian & Marimuthu 2013). This species utilizes rain water droplets to quench their thirst by licking rain droplets from the wing membrane (Baskaran et al. 2016). As stated by the above authors, in the present study also we observed similar behaviours of *P. medius* individuals scratching and licking its body and removing water droplets. The droppings of *P. medius* desecrate human residences, common usage areas, and cause foul odour, but the residents tolerate it and allow roosting colonies on trees in their villages.

The occurrence of mating in the day roost and fellatio behaviour in hetero-sexual pairs was common among *P. medius* individuals (Wilkinson 1986; Kerth et al. 2003; Maruthupandian & Marimuthu 2013; Tan et al. 2009). Similar behaviours while mating during day and female-male fellatio were observed in the current study as stated by the above authors.

## **Emergence from trees**

The emergence time of *P. medius* individuals from the trees varied: early emergence occurred during

winter (1720–1837 h) and delayed emergence during summer (1838–1946 h) in Mohanlal Ganj, Uttar Pradesh (Ramkumar et al. 2019). In the present study the emergence period during the winter season was between 1750–1840 h and it nearly corroborates with the observations of Ramkumar et al. (2019). The time taken for emergence of all the individuals of the colony was found to vary: 21 min to 39 min. The variations of emergence time during summer have not been studied.

### Interactions with other animals

A variety of birds of prey, both Falconiformes and Strigiformes, various reptiles including snakes and lizards prey upon them (Pierson & Rainey 1992). Though monkeys and house crows caused disturbance to *P. medius* individuals, no incidents of predation was reported in the present study area. Villagers remarked that individuals of Black Kites and Black-winged Kites had frequented roosting colonies and predate of juveniles of *P. medius* and hence it corroborates with the findings of and Pierson & Rainey (1992). However, no predation by Black Kites, Black-winged Kites, and reptiles were noticed in the study sites.

## Threats

This species roost on trees that occur close to human settlements, farmlands and sacred groves. Because of human habitation, electrical power lines usually occur close to those roosting trees. Ali (2010) reported small numbers of *P. medius* were found electrocuted and died in Dhubri district, Assam. The present survey revealed that no mortality of *P. medius* individuals was found in the surveyed four districts. Although 84.72 % trees chosen for roosting and 92.1 % *P. medius* individuals (n= 20,600) occurred within a 100-m radius from electrical power lines, no mortality due to electrocution was observed.

Hunting of bats for meat is still prevalent in some parts of Nepal (Katuwal et al. 2019). The meat of flying foxes ('valguli mamsa' in local language) is believed to be of some therapeutic value and its consumption is recommended locally. Meat of this species is consumed for treating rheumatism in India (Nowak 1999) and the people of Attapadi region (Kerala) believe that the meat of *P. medius* treats asthma and chest pain (Padmanaban & Sujana 2008). During the survey, 44 % of residents (n= 35) indicated either occasional or clandestine hunting of *P. medius* for folk-medicinal reasons.

Electromagnetic radiations exert an abnormal behaviour and affect the foraging activities of bats in Aberdeen, Scotland. Their activity was more rigorous in

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the control sites than the sites exposed to a high level (>2v/m) of electromagnetic radiation (Nicholls & Racey 2007). In Mumbai, the number of flying foxes was found to have decreased when mobile-phone towers occurred within 80 m from a roosting colony (Kumar 2010). In the present study the minimum distance between a tree used for roosting and a mobile-phone tower was 40 m at Ongapadi (Vellore district) and the maximum 6,000 m in Maruvur (Viluppuram district). The trees used for roosting and P. medius populations revealed that a large number of trees chosen for roosting (31.94 %; n= 23) and P. medius individuals (50.4 %; n= 11,272) occurred within 500 m radius from the mobile-phone towers. However, in the event of the existence of mobile-phone towers in almost all villages, the situation of a tree 40 m distance from the mobile-phone tower, the exact impact of the mobile-phone tower on the roosting colonies of P. medius needs further study.

## CONCLUSION

The populations of P. medius used 13 tree species belonging to 11 genera and nine families for roosting at various habitats, such as human dwellings, farmlands, and water bodies. No positive relationship occurred between the numbers of P. medius and heights of the trees used for roosting. There was a significant difference between the average number of P. medius and the dbh and the canopy size of trees used by P. medius for roosting. The individuals of P. medius were found soaking themselves in water during summer probably to reduce body temperatures. While roosting, they mostly cling on to tree branches using both legs, rarely using one. Mating and fellatio behaviour in hetero-sexual pairs were observed during the day roost. The time taken for emergence of individuals of the colony from the canopy varied between 20 and 40 min. No mortality due to electrocution was observed. The impact of mobilephone towers on roosting colony needs further study. The roosting populations were disturbed by individuals of Bonnet Macaque, House Crow, Black Kite, and Blackwinged Kite. Anthropogenic impacts like hunting, pruning trees used for roosting and smokes emanated from sacred groves during festivals pose a threat to the populations of P. medius.

In spite of rapid urbanization, industrialization, population increase, habitat destruction, hunting by villagers and decreasing areas of cultivation including orchards, considerable *P. medius* populations exist in the study area. A special management plan could be devised for the area, considering the anthropogenic and natural stresses to which the habitat is currently subjected. The present roosting sites should be declared as protected areas and further organisations (NGOs) have to play a major role in creating awareness among the general public to protect this species. This study clearly demonstrates the presence of 22,365 Indian Flying Fox individuals in their natural habitats and identifies current and emerging challenges in conservation of habitats of such key species in the natural ecosystems.

## REFERENCES

- Acharya, P.R. (2008). Status and distribution of Indian Flying Fox in Kathmandu Valley, Nepal. *Bat Net-CCISNA Newsletter* 9 (1): 19–20.
- Ali, A. (2010). Population trend and conservation status of Indian Flying Fox, *Pteropus giganteus* (Brunnich, 1872) (Chiroptera: Pteropodidae) in western Assam. *The Ecoscan* 4(4): 311–312.
- Barlow, K. (1999). Expedition Field Techniques: Bats. Expedition Advisory Centre. Royal Geographical Society, London, 66 pp.
- Baskaran, S., A. Rathinakumar, J. Maruthupandian, P. Kaliraj & G. Marimuthu (2016). The effect of daytime rain on the Indian Flying Fox (Mammalia: Chiroptera: Pteropodidae: *Pteropus giganteus*). Journal of Threatened Taxa 8(2): 8499–8502. https://doi.org/10.11609/jott.1959.8.2.844-8502
- Blozan, W. (2006). Tree measuring guidelines of the eastern native tree society. Bulletin of the East Native Tree Society 1(1): 3–10.
- Bates, P.J.J. & D.L. Harrison (1997). Bats of the Indian subcontinent. Harrison Zoological Museum Publications. Sevenoaks, 258 pp.
- Chakravarthy, A.K. & H.M. Yeshwanth (2008). Status of roost of Indian Fruit Bat (*Pteropus giganteus*) in Karnataka, South India. *Bat Net-CCISNA Newsletter* 9: 16–18.
- Dey, S., U.P. Roy & S. Chattopadhyay (2015). Effect of heat wave on the Indian Flying Fox *Pteropus giganteus* (Mammalia: Chiroptera: Pteropodidae) population from Purulia district of West Bengal. *Journal of Threatened Species* 7(3): 7029–7033. https://doi. org/10.11609/jott.03947.7029-33
- Fenton, M.B. & R.M.R. Barclay (1980). Myotis lucifugus. Mammalian Species 142(1): 1–8.
- Fujita, M.S. & M.O. Tuttle (1991). Flying foxes (Chiroptera: Pteropodidae): threatened animals of key ecological and economic importance. *Conservation Biology* 5(4): 455–463.
- **Gulraiz, T.L. (2014).** Roost characteristics, food and feeding habits of the Indian Flying Fox (*Pteropus medius*) in Lahore. PhD Thesis, University of Veterinary and Animal Sciences, Lahore.
- Helgen, K.M., L.E. Helgen & D.E. Wilson (2009). Pacific flying foxes (Mammalia: Chriroptera): two new species of *Pteropus* from Samoa, Probably extinct. *American Museum Novitates* 3646: 1–37.
- Jnawali, S.R., H.S. Baral, S. Lee, K.P. Acharya, G.P. Upadhyay, M. Pandey, R. Shrestha, D. Joshi, B.R. Laminchhane, Katuwal, H.B., B. Kushwala & R.C. Quan (2019). Indian Flying Fox Pteropus giganteus if declining in lowland Nepal: Need of conservation action. Journal of Bat Conservation and Research 12 (1): 60–63.
- Kerth, G., B. Almasi, N. Ribi, D. Thiel & S. Lupold (2003). Social interactions among wild female Bechstein's bats (*Myotis bechsteinii*) living in a maternity colony. *Acta Ethologia* 5(2): 107–114.
- Khan, W., N.N. Nisa, A.R. Khan, B. Rahbar, S.A. Mehmood, S. Ahmed, M. Kamal, M. Shah, A. Rasool & T.H. Kunz (1982). Roosting Ecology. In: Kunz, T.H. (ed.). *Ecology of Bats*. Plenum Publishing Corporation, New York, 55pp.
- Kumar, G. (2010). Report on Cell Tower Radiation, IIT Bombay, Powai, Mumbai submitted to Secretary, DOT, Delhi, 50 pp. ee.iitb. ac.in/~mwave/GK-cel-tower-rad-report-DOT-Dec2010.pdf Accessed

on 10 February 2021.

- Kumar, R. & V. Elangovan (2019). The effect of tree characteristic on roost selection of the Indian Flying Fox, *Pteropus giganteus. Bat Research and Conservation* 12(1): 100–106.
- Kumar, R., D.N. Prasad & V. Elangovan (2017). The effect of seasonal changes on emergence behaviour of the Indian Flying Fox *Pteropus* giganteus. Proceedings of the Zoological Society, Kolkata. Accessed on 10 February 2021. https://doi.org/10.1007/s12595-018-0269-8
- Manandhar, S., S. Thapa, T.K. Shretha, R. Jyakhwo, W. Wright & A. Aryal (2018). Population status and diurnal behaviours of the Indian Flying Fox Pteropus giganteus (Brunnich, 1782) in Kathmandu valley, Nepal. Proceedings of the Zoological Society 71(4): 363–375.
- Marimuthu, G. (1996). Nature watch. *Resonance* 1: 103. https://doi. org/10.1007/BF02835626
- Maruthupandian, J. & G. Marimuthu (2013). Cunnilingus increases duration of copulation in the Indian Flying Fox *Pteropus giganteus*. *PLOS One* 8(3): e59743.
- Mickleburgh, S.P., A.M. Hutson & P.A. Racey (2002). A review of the global conservation status of bats. *Oryx* 36(1): 18–34.
- Mildenstein, T.L., S.C. Stier, C.E. Nuevo-Diego, L.S. Mills & C.N. Diego (2005). Habitat selection of endangered and endemic large flyingfox in Subic Bay, Philippines. *Biological Conservation* 126(1): 93–103.
- Mishra, R., S. Dookia & P. Bhattacharya (2010). Avenue plantations as biodiversity havens: A case study of population status of the Indian Flying Fox *Pteropus giganteus* (Brunnich, 1782) and implication for its conservation in the urban megacity Delhi, India. *Proceedings of the Zoological Society* 7: 127–136.
- Molur, S., C. Srinivasulu, P. Bates & C. Francies (2008). *Pteropus* giganteus. In: IUCN 2011. IUCN RedList of Threatened Species. Version, 2021.2. <www.iucnredlist.org> Accessed on 05 October 2021.
- Nicholls, B. & P.A. Racey (2007). Bats avoid radar installations: Could Electromagnetic fields deter Bats from colliding with wind turbines? *PLOS ONE* 2(3):e 297.
- Nowak, R.M. (1999). Walker's Mammals of the World. Johns Hopkins University Press, 1,936 pp
- Padmanabhan, P. & K.A. Sujana (2008). Animal products in traditional medicine from Attappady hills of Western Ghats. Indian Journal of Traditional Knowledge 7(2): 326–329.
- Pierson, E.D. & W.E. Rainey (1992). The biology of flying foxes of the genus *Pteropus*: A review. In: Wilson, D.E. & G.L. Graham (ed.). Pacific Island Flying Foxes. Proceedings of an International Conservation Conference, Washington, D.C, U.S. Fish and Wildlife Services Biological Report 90: 1–17.
- Rao, S. & G. Poyyamoli (2017). Roosting, foraging and mating behaviours of Indian Flying Fox (*Pteropus giganteus*) in Rourkela,

Odisha. July 22, 2017. Available at SSRN: https://doi.org/10.2139/ ssrn.3007088

- Simmons, N.B. & A.L. Cirranello (2020). Bat species of the world: a taxonomic and geographic database. Accessed on 05 October 2021. https://batsnames.org
- Srinivasulu, C., A. Srinivasulu & B. Srinivasulu (2021a). Checklist of the bats of South Asia (v1.5). https://threatenedtaxa.org/index.php/ JoTT/checklists/bats/southasia
- Srinivasulu, C., A. Srinivasulu & B. Srinivasulu (2021b). Checklist of the bats of India (v1.2). https://threatenedtaxa.org/index.php/JoTT/ checklists/bats/india
- Stier, S.C. & T.L. Mildenstein (2005). Dietary habits of the world's largest bats: the Philippine Flying Foxes, Acerodon jubatus and Pteropus vampyrus lanensis. Journal of Mammalogy 86: 719–728.
- Sudhakaran, M.S., D.P. Swamidoss & P. Parvathiraj (2010). Emergence and returning activity in the Indian Flying Fox, *Pteropus giganteus* (Chiroptera: Pteropodidae). *International Journal of Geography and Geology* 1(1): 1–9.
- Tan, M., G. Jones, G. Zhu, J. Je, T. Hong, S. Zhou, S. Zhang & L. Zhang (2009). Fellatio by fruit bats prolonging copulation time. *PLOS ONE* 4(1): e7595.
- Tangavelou, A.C., P.J. Rani & S. Karthikeyan (2013). Conservation of sacred Indian Flying Fox (Bat) at sacred landscape of Pudukkottai district, Tamil Nadu, India. *Asian Journal of Conservation Biology* 2(2): 178–180.
- Thapa, S.B. (2008). Reporting *Pteropus* colonies and bat roosts from Eastern Nepal. *BatNet-CCISNA Newsletter* 9(1): 22–23.
- Thomas, D.W. (1988). The distribution of bats in different ages of Douglas-fir forest. *Journal of Wildlife Management* 52: 619–626.
- Tsang, S.M. (2020). Pteropus giganteus. IUCN Red List of Threatened Species.e.T18725A22081011.Accessed on 10February 2021. https:// doi.org.10.2305/IUCN-UK.2020-3/RLTS:T18725A194134899.en
- Vijayasankar, R., K. Ravikumar & P. Ravichandran (2012). Plant Resources of Tiruvannamalai district, Tamil Nadu, India. Bishen Singh Mahendra Pal Singh Publication, New Delhi, 756 pp.
- Vyas, R. & K. Upadhyay (2014). Study of the Indian Flying Fox (*Pteropus giganteus*) colonies of Jambughoda Wildlife Sanctuary, Gujarat, India: Record of largest roosting congregation at Targol. CCINSA & RISCINSA Newsletter 6(1): 1–6.
- Welbergen, J.A., S.M. Klose, N. Markus & P. Eby (2008). Climate changes and effects of temperature extremes on Australian flying foxes. *Proceedings of Royal Society B* 275: 419–425.
- Wilkinson, S.G. (1986). Social grooming in the common Vampire Bat, Desmodua rotundus. Animal Behaviour 34: 1880–1889.
- www.tn.gov.in (2021). Tamil Nadu Government Portal. Profile of Tamil Nadu. Accessed on 10 February 2021.



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#### Articles

Roosting habits and habitats of the Indian Flying Fox Pteropus medius Temminck, 1825 in the northern districts of Tamil Nadu, India – M. Pandian & S. Suresh, Pp. 19675–19688

\_\_\_\_\_

### Diversity and distribution of avifauna at Warathenna-Hakkinda Environmental Protection Area in Kandy, Sri Lanka

 – Dinelka Thilakarathne, Tithira Lakkana, Gayan Hirimuthugoda, Chaminda Wijesundara & Shalika Kumburegama, Pp. 19689–19701

Grass species composition in tropical forest of southern India

- M. Ashokkumar, S. Swaminathan & R. Nagarajan, Pp. 19702–19713

#### Communications

Habitat use and conservation threats to Wild Water Buffalo Bubalus arnee (Mammalia: Artiodactyla: Bovidae) in Koshi Tappu Wildlife Reserve, Nepal – Reeta Khulal, Bijaya Neupane, Bijaya Dhami, Siddhartha Regmi, Ganesh Prasad Tiwari & Manita Parajuli, Pp. 19714–19724

Get my head around owls: people perception and knowledge about owls of Andaman Islands

– Shanmugavel Sureshmarimuthu, Santhanakrishnan Babu, Nagaraj Rajeshkumar & Honnavalli Nagaraj Kumara, Pp. 19725–19732

Abundance and diversity of threatened birds in Nangal Wetland, Punjab, India – Rajwinder Kaur & Onkar Singh Brraich, Pp. 19733–19742

Evaluation of fish diversity and abundance in the Kabul River with comparisons between reaches above and below Kabul City, Afghanistan

– Ugyen Kelzang, Ahmad Farid Habibi & Ryan J. Thoni, Pp. 19743–19752

New record of *Myrmarachne melanocephala* MacLeay, 1839 (Araneae: Salticidae) from Jharkhand, India and biogeographical implications of the co-occurrence of its ant model *Tetraponera rufonigra* Jerdon, 1851

- Rahul Kumar, Mirtunjay Sharma & Ajay Kumar Sharma, Pp. 19753-19761

Diversity of spiders (Arachnida: Araneae) and the impact of pruning in Indian sandalwood plantations from Karnataka, India

– S. Padma 1 & R. Sundararaj, Pp. 19762–19772

## New records of cheilostome Bryozoa from the eastern coast of India encrusting on the exoskeleton of live horseshoe crabs of Indian Sundarbans

 – Swati Das, Maria Susan Sanjay, Basudev Tripathy, C. Venkatraman & K.A. Subramanian, Pp. 19773–19780

On the pteridophytes of Bherjan-Borajan-Padumoni Wildlife Sanctuary, Assam, India – Pranjal Borah & Jayanta Barukial, Pp. 19781–19790

Population status of *Heritiera fomes* Buch.-Ham., a threatened species from Mahanadi Mangrove Wetland, India

– Sudam Charan Sahu, Manas Ranjan Mohanta & N.H. Ravindranath, Pp. 19791–19798

Additions to the lichenized and lichenicolous fungi of Jammu & Kashmir from Kishtwar High Altitude National Park

 Vishal Kumar, Yash Pal Sharma, Siljo Joseph, Roshinikumar Ngangom & Sanjeeva Nayaka, Pp. 19799–19807

#### **Short Communications**

Is release of rehabilitated wildlife with embedded lead ammunition advisable? Plumbism in a Jaguar *Panthera Onca* (Mammalia: Carnivora: Felidae), survivor of gunshot wounds – Eduardo A. Díaz, Carolina Sáenz, E. Santiago Jiménez, David A. Egas & Kelly Swing, Pp. 19808–19812

New record of the Sewing Needle Zipper Loach *Paracanthocobitis linypha* Singer & Page, 2015 (Teleostei: Cypriniformes: Nemacheilidae) from the Chindwin drainage of Manipur, India

- Yumnam Rameshori, Yengkhom Chinglemba & Waikhom Vishwanath, Pp. 19813-19817

Field identification characters to diagnose *Microhyla mukhlesuri* from closely related *M. mymensinghensis* (Amphibia: Microhylidae) and range extension of *M. mukhlesuri* up to West Bengal State, India

- Suman Pratihar & Kaushik Deuti, Pp. 19818-19823

First report of *Scipinia horrida* (Stål) (Heteroptera: Reduviidae) from Assam, with comments on related genus *Irantha* Stål – Anjana Singha Naorem, Santana Saikia, Anandita Buragohain, Rubina Azmeera Begum, Swapnil S. Boyane & Hemant V. Ghate, Pp. 19824–19830

Flesh fly (Diptera: Sarcophagidae): male terminalia, diversity and expanded geographical distribution from India

 Kanholi Sreejith, Shuvra Kanti Sinha, Santanu Mahato & Edamana Pushpalatha, Pp. 19831– 19836

Checklist of moths (Heterocera) of Tadong, Sikkim, India

- Prayash Chettri, Yuki Matsui, Hideshi Naka & Archana Tiwari, Pp. 19837-19848

## New distribution records of *Begonia* L., *B. murina* Craib and *B. poilanei* Kiew (Begoniaceae: Cucurbitales) for Laos

 Phongphayboun Phonepaseuth, Phetlasy Souladeth, Soulivanh Lanorsavanh, Shuichiro Tagane, Thyraphon Vongthavone & Keooudone Souvannakhoummane Pp. 19849–19854

#### Notes

A recent sighting of the Stripe-backed Weasel *Mustela strigidorsa* (Mammalia: Carnivora: Mustelidae) in Hkakabo Razi Landscape, Myanmar

– Sai Sein Lin Oo, Tun Tun, Kyaw Myo Naing & Paul Jeremy James Bates, Pp. 19855–19859

Are the uplifted reef beds in North Andaman letting nesting Olive Ridley Sea Turtle Lepidochelys olivacea stranded?

– Nehru Prabakaran, Anoop Raj Singh & Vedagiri Thirumurugan, Pp. 19860–19863

First record of the orb-weaving spider Araneus tubabdominus Zhu & Zhang, 1993 (Araneae: Araneidae) from India

- Souvik Sen, John T.D. Caleb & Shelley Acharya, Pp. 19864–19866

The genus Catapiestus Perty, 1831 (Coleoptera: Tenebrionidae: Cnodalonini) from Arunachal Pradesh with one new record to India – V.D. Hegde & Sarita Yadav, Pp. 19867–19869

Rediscovery and extended distribution of *Indigofera santapaui* Sanjappa (Leguminosae: Papilionoideae) from the states of Maharashtra and Gujarat, India – Kumar Vinod Chhotupuri Gosavi, Sanjay Gajanan Auti, Sharad Suresh Kambale & Munivenkatappa Sanjappa, Pp. 19870–19873

## Additional distribution records of *Ceropegia anjanerica*, an endemic and 'Endangered' lantern flower of the northern Western Ghats, India

 Samir Shrikant Maity, Ajay Natha Gangurde, Sharad Suresh Kambale, Avinash Ramchandra Gholave, Avinash Asraji Adsul, Ganesh Babaso Pawar & Kumar Vinod Chhotupuri Gosavi, Pp. 19874–19877

## Notes on the extended distribution of *Impatiens megamalayana*, a recently described balsam in Western Ghats, India

– Anoop P. Balan & A.J. Robi, Pp. 19878–19883

#### **Book Review**

A look over on the scented tree of India (Santalum album) - S. Suresh Ramanan & A. Arunachalam, Pp. 19884–19886

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