

## FIRST ECOLOGICAL DATA OF FLYING FOXES (Chiroptera: Pteropodidae) IN VIETNAM

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**ABSTRACT:** Flying fox is the common name of all fruit bat species of the genus *Pteropus*. Prior to this study, Vietnamese flying foxes were poorly studied and their ecology was almost unknown. To fill this gap, we conducted monthly surveys between January and September 2014 in Soc Trang province with emphasis on variations of colony size, diet and roosting behavior of flying foxes. The surveys included observational counting, field identification of flying foxes and identification of food samples and their roosting trees. Results from the surveys indicated that the colony comprises two species, the larger of which is *Pteropus lylei* and the smaller one is provisionally identified as *Pteropus* cf. *hypomelanus*. Although there are nearly one thousand trees in the study site, flying foxes roost under the canopies of very few. The colony size varies weekly, monthly and seasonally with a total number of individuals ranging between 453 in April and 1,753 in February. This paper also provides a risk assessment and recommendations for urgent conservation of these threatened mammals.

**Keywords:** *Pteropus*, conservation, ecology, mammalia, monitoring.

### INTRODUCTION

Flying foxes (*Pteropus* spp.) comprises 65 species worldwide (Simons 2005) [9]. Of which, three species, viz. *P. hypomelanus*, *P. lylei* and *P. vampyrus*, are known from Vietnam [5, 9, 12]. They were widely recorded in the South Central and Mekong Delta regions of the country [12]. Unfortunately, they were critically threatened by habitat loss and illegal hunting [10, 12]. Therefore, these species are survived within only five narrow sites of the Mekong Delta region: Can Gio Biosphere Reserve of Ho Chi Minh city, Con Dao National Park of Ba Ria-Vung Tau province, Hon Khoai island of Ca Mau province, Phu Quoc National Park of Kien Giang province and Soc Trang city of Soc Trang province [5, 12].

Historically, the first published records of flying foxes from Vietnam were included in Peters (1869) [7], which also appears as the first published literature regarding the bat fauna of the country [3, 13]. Subsequently, records of these bat species were included in several publications [1, 3, 10, 12]. Peters (1869) classified materials from Condor Island, an island of the Con Dao Archipelago National

Park in southern Vietnam, as a new species, namely *Preropus condorensis*. However, Corbet & Hill (1992) [2] listed the “*Preropus condorensis*” as a synonym of *Pteropus hypomelanus* whilst Simmons (2005) [9] treated it as a subspecies of *Pteropus hypomelanus*. Kruskop (2013) [5] examined the type specimen of “*Preropus condorensis*” and identified two recently collected specimens from Condor Island as *Pteropus hypomelanus*. Nevertheless, the taxonomic status of “*Preropus condorensis/hypomelanus*” is still unclear. In fact, all previous publications including Corbet & Hill (1992) [2], Simmons (2005) [9] and Kruskop (2013) [5] did not provide any taxonomic assessment of the species. Therefore, we provisionally treat materials of small flying foxes from Vietnam as *Pteropus* cf. *hypomelanus* and hope to resolve its taxonomy in the future. Over the past ten years, numbers of flying fox colonies and individuals of each colony have been critically decreased [12, 13]. In Soc Trang province, which is home to the most important colony of flying foxes in Vietnam, the People’s Committee has issued and implemented a provincial law for protection of flying foxes

throughout its territory. Unfortunately, the local law is likely to be ineffective. The local authorities have tried their best with considerable efforts but they lack knowledge of the issue and how to implement the policy. Logically, without an appropriate ecological background, strategies for conservation of bats and general biodiversity are likely to be impractical.

To fill the current gap as well as strengthen local laws for effective conservation of Vietnamese flying foxes, with supports from the Food and Agriculture Organization (FAO) of the United Nations, the People's Committee of Soc Trang province through the Department of Science and Technology, we conducted an ecological study of the flying fox colony in Soc Trang province. This paper provides initial results from our study with emphases on their roosting behavior, common food compositions and colony size variations.

## MATERIALS AND METHODS

Field surveys were conducted monthly at Soc Trang city of Soc Trang province, between

January and September in 2014. Flying foxes were counted precisely at their roosts through observation in the daytime by the second and third authors. Additionally, four stations around their roosts were also designated for counting in the evening and early morning. Counters, binoculars, cameras and video cameras were employed during all observational processes for maximum accuracy of the results. Daily number of flying foxes is the average of counting numbers from all counters.

All trees within the studied site were identified by a senior botanist of IEBC, Dr. Ha Van Tue, then numbered and mapped to assess the roosting behavior of the flying foxes colony (fig. 1). Food composition was identified based on remaining fruits under the roosts and seeds in randomly selected fecal samples. Results from direct observation during moonlight nights also supported and provided additional data on the food composition. Dead individuals (fig. 2) of flying foxes under the roosts were collected for an examination of their taxonomy at IEBC by the first author. Reproductive status of flying foxes was assessed following Racey (2009) [8].



Figure 1. Mapping the trees of the study site



Figure 2. A dead flying fox at the study site

## RESULTS AND DISCUSSION

### Current status and variations of colony size

The studied colony of flying foxes in Soc Trang varies between 453 and 1,753 individuals. The obtained results indicated that the colony varied weekly and monthly (tables 1, 2). The highest and lowest numbers of flying foxes were recorded in February and April, respectively. The monthly variation corresponds

with the food sources of flying foxes. Between February and May is the beginning of annual fruit season in Soc Trang and surrounding province. Therefore, numbers of flying foxes at the study site are much higher than those in remaining months of the year.

The colony was also strongly threatened by human activities. In April, when the Chol Chnam Thmay traditional festival of local people was organized at the study site, flying foxes were

disturbed by noise, smoke and tourists' activities. Very few flying foxes remained at the study site during the festival (table 1). It is noticeable that the festival occurs annually, in the breeding season of flying foxes and numbers of tourists visiting the site during the festival have

continuously increased since 2004. The flying fox colony also exhibited a weekly variation. Numbers of flying foxes during the week days are much higher than those at the weekend (table 2). The variation corresponds to daily variations of tourist numbers.

**Table 1.** Monthly variations and breeding indicator of the flying fox colony Soc Trang province during 2014

Date of surveys	Mean $\pm$ SD	Pub*
20th Jan.	1169 $\pm$ 27	0
27 <sup>th</sup> Feb.	1753 $\pm$ 39	0
29 <sup>th</sup> Mar.	633 $\pm$ 7	0
15 <sup>th</sup> Apr.	453 $\pm$ 4	0
29 <sup>th</sup> Apr.	1278 $\pm$ 20	56 $\pm$ 2
29 <sup>th</sup> May	1627 $\pm$ 15	173 $\pm$ 4
15 <sup>th</sup> June	1080 $\pm$ 19	109 $\pm$ 3
28 <sup>th</sup> Jun.	998 $\pm$ 21	125 $\pm$ 3
16 <sup>th</sup> Jul.	887 $\pm$ 11	109 $\pm$ 2
26 <sup>th</sup> Jul.	753 $\pm$ 6	95 $\pm$ 1
16 <sup>th</sup> Aug.	976 $\pm$ 18	102 $\pm$ 2
23 <sup>rd</sup> Aug.	1111 $\pm$ 21	114 $\pm$ 3
12 <sup>th</sup> Sep.	1485 $\pm$ 28	100 $\pm$ 2

**Table 2.** Weekly variation of the flying fox colony between 03rd and 14th September 2014

Date	Numbers of flying foxes
3 <sup>rd</sup> Wed	1314 $\pm$ 25
4 <sup>th</sup> Thu	1278 $\pm$ 22
5 <sup>th</sup> Fri	1089 $\pm$ 16
6 <sup>th</sup> Sat	1023 $\pm$ 17
8 <sup>th</sup> Mon	1440 $\pm$ 26
9 <sup>th</sup> Tue	1469 $\pm$ 31
10 <sup>th</sup> Wed	1470 $\pm$ 28
11 <sup>th</sup> Thu	1537 $\pm$ 26
12 <sup>th</sup> Fri	1485 $\pm$ 28
13 <sup>rd</sup> Sat	1320 $\pm$ 30
14 <sup>th</sup> Sun	1217 $\pm$ 18

\*Observed pups were carried by female flying foxes.

### Roosting behavior of flying foxes

Vegetation of the study site is quite diverse in terms of species and canopy layers. It is noticeable that flying foxes only roosted in very few trees, which are higher than 15 meters, among nearly 2,000 trees within the study site. They daily leave their roosts around 18:00 h and return between 03:00 h and 05:00 h.

### Food composition

Two different species of flying foxes were observed at the study site during the field surveys. Six individuals of the larger species were randomly captured by the first author and others in 2013 and identified as *Pteropus lylei*. The smaller form is quite similar to *Pteropus* cf. *hypomelanus*. Within the aims of this study, we investigated the food composition of *Pteropus lylei*. Four plant species: tropical almond, *Terminalia catappa*; brown-woolly fig, *Ficus drupacea*; Calabur tree, *Muntingia calabura* and sacred fig, *Ficus religiosa* provide food for *Pteropus lylei* within and surrounding the study site (fig. 3).



**Figure 3.** Food remains of *Pteropus lylei* at the roosting site in Soc Trang province from two plant species: *Terminalia catappa* (A) and *Ficus drupacea* (B, C).

To minimize the disturbance to flying foxes in Soc Trang province, the traditional festival should be organized outside the study site or at least one kilometer from the flying foxes' roosting site. Results from a previous study indicated that flying foxes in Soc Trang

province forage daily up to 50 kilometers from their roosts. Information from the present study is insufficient to confirm a hypothesis regarding the selection of roosts by flying foxes. It is very likely that flying foxes prefer old trees to the younger ones. In fact, all trees in which the flying fox colony roosts are older than 20 years. Further studies on the ecology of the flying fox colony are clearly required to provide further information for timely and effective conservation strategies.

Published information about the diet of *Pteropus lylei* is sparse. Lanlua et al. (2007) [6] indicated that *Pteropus lylei* “consumes only ripe fruit, which contains low protein and sodium”. Dietary samples collected during the present study also exhibit the remains of ripe fruits.

## CONCLUSION

Flying foxes currently remain within the Mekong Delta region of Vietnam with only two permanent roosts: Soc Trang province and Ho Chi Minh city.

Chu Doi pagoda in Soc Trang province is currently a home to two different species of flying foxes: the larger is *Pteropus lylei* whilst the smaller likely belongs to *Pteropus* cf. *hypomelanus*.

The colony of *Pteropus lylei* at Chua Doi pagoda exhibits weekly, monthly and seasonally variations ranging between 453 and 1,753 individuals.

The flying foxes roost only beneath the canopy of trees older than 20 years. They leave the roost daily around 18:00 h and return between 03:00 h and 05:00 h.

*Pteropus lylei* in Vietnam feeds on at least four plant species: *Terminalia catappa*, *Ficus drupacea*, *Muntingia calabura* and *Ficus religiosa*.

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## DẪN LIỆU ĐẦU TIÊN VỀ SINH THÁI HỌC CỦA DƠI NGỰA (Chiroptera: Pteropodidae) Ở VIỆT NAM

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### TÓM TẮT

Dơi ngựa là tên phổ thông của tất cả những loài dơi ăn quả thuộc giống *Pteropus*. Trước khi nghiên cứu này được thực hiện, hầu như chưa có dẫn liệu nào về sinh thái của những loài dơi ngựa ở Việt Nam cũng như các nước trong khu vực Đông Nam Á. Nhằm góp phần khắc phục sự thiếu dẫn liệu đó, chúng tôi đã thực hiện những đợt điều tra thực địa theo định kỳ mỗi tháng một lần (từ tháng 1 đến tháng 9 năm 2014) ở tỉnh Sóc Trăng; tập trung nghiên cứu sự thay đổi số lượng cá thể trong đàn dơi ngựa, thành phần thức ăn và tập tính đậu của chúng. Các đợt điều tra thực địa bao gồm: đếm số lượng cá thể qua quan sát ban ngày, thu và định loại những mẫu thức ăn của dơi, định loại những cá thể dơi quan sát được và những cây có dơi đậu. Đàn dơi ở khu vực nghiên cứu gồm hai nhóm cá thể được định danh là *Pteropus lylei* và *Pteropus* cf. *hypomelanus*. Trong số gần hai nghìn cây ở khu vực nghiên cứu, dơi ngựa chỉ đậu ở một số ít cây trên 20 năm tuổi. Số lượng cá thể trong đàn dơi thay đổi theo chu kỳ ngày trong tuần, thay đổi qua từng tháng và mùa trong năm với số lượng cá thể trong khoảng từ 453 đến 1.753. Bài báo này cũng cung cấp dẫn liệu đầu tiên về thức ăn của dơi ngựa ở Việt Nam cũng như ở khu vực Đông Nam Á, môi đe dọa đối với đàn dơi ngựa và một số đề xuất nhằm bảo tồn chúng kịp thời trong thời gian tới.

*Từ khóa:* Mammalia, *Pteropus*, bảo tồn, sinh thái học, phân loại học.

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