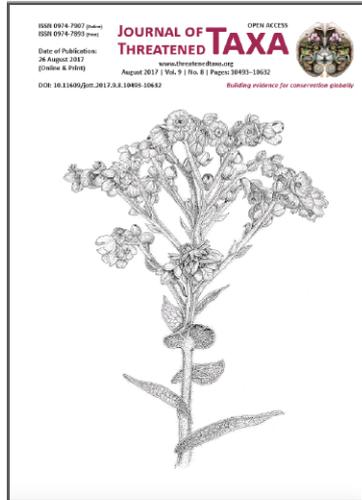


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### COMMUNICATION

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## THE ECOLOGY AND DISTRIBUTION OF FLYING FOXES (CHIROPTERA: PTEROPODIDAE: *PTEROPUS*) IN TANINTHARYI REGION, MYANMAR WITH A FIRST MAINLAND RECORD OF *PTEROPUS HYPOMELANUS GEMINORUM* FROM MYEIK

### OPEN ACCESS

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**Abstract:** Roosting colonies of *Pteropus* spp. at Myeik and Nyaung-zin in Myanmar's Tanintharyi Region were surveyed between March and October 2016. Flying Foxes from 12 roost sites in Myeik town are considered to represent the taxon *Pteropus hypomelanus geminorum* based on the collection of a single specimen, which is the first record of the taxon from a mainland location. Further information was gathered from local people concerning the ecology and seasonal migration of Flying Fox colonies at the coastal village of Shaw-Taw-Maw and on the small island of The-byu. Data are presented on the roost tree species selected by *Pteropus* colonies and local threats to the bats and their habitat.

**Keywords:** Ecology, Myanmar, *Pteropus hypomelanus geminorum*.

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**Author Contribution:** All authors contributed to the writing of the paper. Fieldwork was undertaken by K.S.O. and H.L.W.

For Myanmar abstract see end of this article.

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## INTRODUCTION

Nearly one quarter of South-East Asian Fruit Bat (Pteropodidae) species are projected to become globally extinct by the end of the 21<sup>st</sup> century, with Flying Foxes of the genera *Pteropus* and *Acerodon* being particularly at risk (Lane et al. 2006). In many parts of South-east Asia, the hunting of Flying Foxes for bushmeat and for their perceived medicinal properties is causing a significant decline in numbers (Mickleburgh et al. 2009; Mildenstein et al. 2016). While this is notably the case in Vietnam (Thong 2004), Thailand (Robinson 1993), Lao PDR (Francis et al. 1999), and Cambodia (Ravon et al. 2014), the situation in Myanmar is not as severe, where large colonies are still found in a number of areas in Upper Myanmar, especially at Bagan and Mandalay (Bates et al. 2000) and at Sittwe (Struebig et al. 2005). Data on the taxonomy, ecology, and distribution of Flying Foxes in Lower Myanmar (notably in Tanintharyi, Lower Myanmar's largest region), however, are scarce, with little information having been provided before or since the brief reports of Wroughton (1915) and Lindsay (1926).

Wroughton (1915) states that, "*Pteropus* [is] said to be plentiful, especially at Mergui [Myeik] at certain times of the year". The author adds (without reference to actual material) that in southern Tenasserim [Tanintharyi] there are three species: *Pteropus hypomelanus geminorum*, *P. intermedius* (which Wroughton (1915) limits subsequently to the type locality of Amherst [Kyaikkami] in Mon State) and *P. lylei*. *P. lylei* is thought to be restricted currently to Cambodia, China, Thailand, and Vietnam and is not known to occur in Myanmar (Bumrungsri et al. 2008). Lindsay (1926) reports *P. vampyrus malaccensis* [= *P. vampyrus*] from mainland Tanintharyi at Mergui Town [Myeik] based on five specimens (4 males, 1 female) and from five inshore islands or island groups in the Mergui [Myeik] Archipelago (Tavoy Is. [Mali Kyun] (9 females), Kisseraing Is. [Kanmaw Kyun] (6 females), the Gregory Group (1 male), Malcolm Is. [Ale-man Kyun] (1 female), and Barwell Is. (2 females)). The same authoress states that *P. h. geminorum* was found on Sir John Hayes Is. [= Kunthi Kyun] during a survey in 1921/22 but does not refer to actual specimens. In his original description of *Pteropus geminorum*, Miller (1903) states that he examined 15 specimens (seven skins) from South Twin Island, including the type, an adult female.

In his study of specimens of *Pteropus satyrus* Andersen, 1908 from the Andaman Islands, Andersen

(1912) considers the taxon to be most closely related to *P. h. geminorum* from the Myeik Archipelago. This view is contradicted by Hill (1971), who positions *P. satyrus* as a subspecies of *P. melanotus* Blyth, 1863 based on colour, size and dental measurements. Hill (1971) does, however, note the close parallel between the combined colour variation of subspecific forms of *P. melanotus* and the colour variation in *P. h. geminorum*. Conversely, Bates & Harrison (1997) synonymise *satyrus* with *P. hypomelanus* on the basis that the skin and skull of the holotype of *P. satyrus* cannot be differentiated from examples of *P. h. geminorum* from the Myeik Archipelago.

The species accepted currently as occurring in Tanintharyi Region are *Pteropus hypomelanus* Temminck, 1853 (represented in the Myeik Archipelago by the subspecies *geminorum* Miller, 1903) (see Mickleburgh et al. 1992) and *P. vampyrus* (Linnaeus, 1758) (see Bates et al. 2008).

In order to update and augment the distribution information given in Wroughton (1915) and Lindsay (1926) and to provide new data on the ecology of Flying Fox colonies in Tanintharyi Region, a team comprising seven members from Myeik University undertook a survey of *Pteropus* colonies at four localities in the region between March and October 2016. Particular reference is made to the tree species that were noted to support *Pteropus* colonies, the number of Flying Foxes present on each tree species at the time observations were made, and threats to the colonies and their immediate habitat.

## STUDY AREA

Surveys took place in Zay-dan Quarter and Seiknge Quarter in Myeik Town (12.43777778 N & 98.59638889 E) and in Nyaung-zin village, 11km south of Dawei (13.98694444 N & 98.23555556 E) (Fig. 1). Questionnaires were distributed amongst local people in the three localities mentioned and also in the coastal village of Shaw-taw-maw (12.04611111 N & 98.67166667 E), 44km south of Myeik and on the small island of Thebyu (12.08722222 N & 98.61250000 E), 38km south of Myeik. Thebyu lies 1.2km from the mainland and 14km east of Sakhan Thit Kyun (Sellore Island).

The entirety of Myanmar, other than the northernmost areas of Sagaing Region and Kachin State, lies within the Indo-Burma Hotspot as defined by Conservation International ([www.cepf.net](http://www.cepf.net)). Myeik Town and Nyaung-zin are located in the Vulnerable

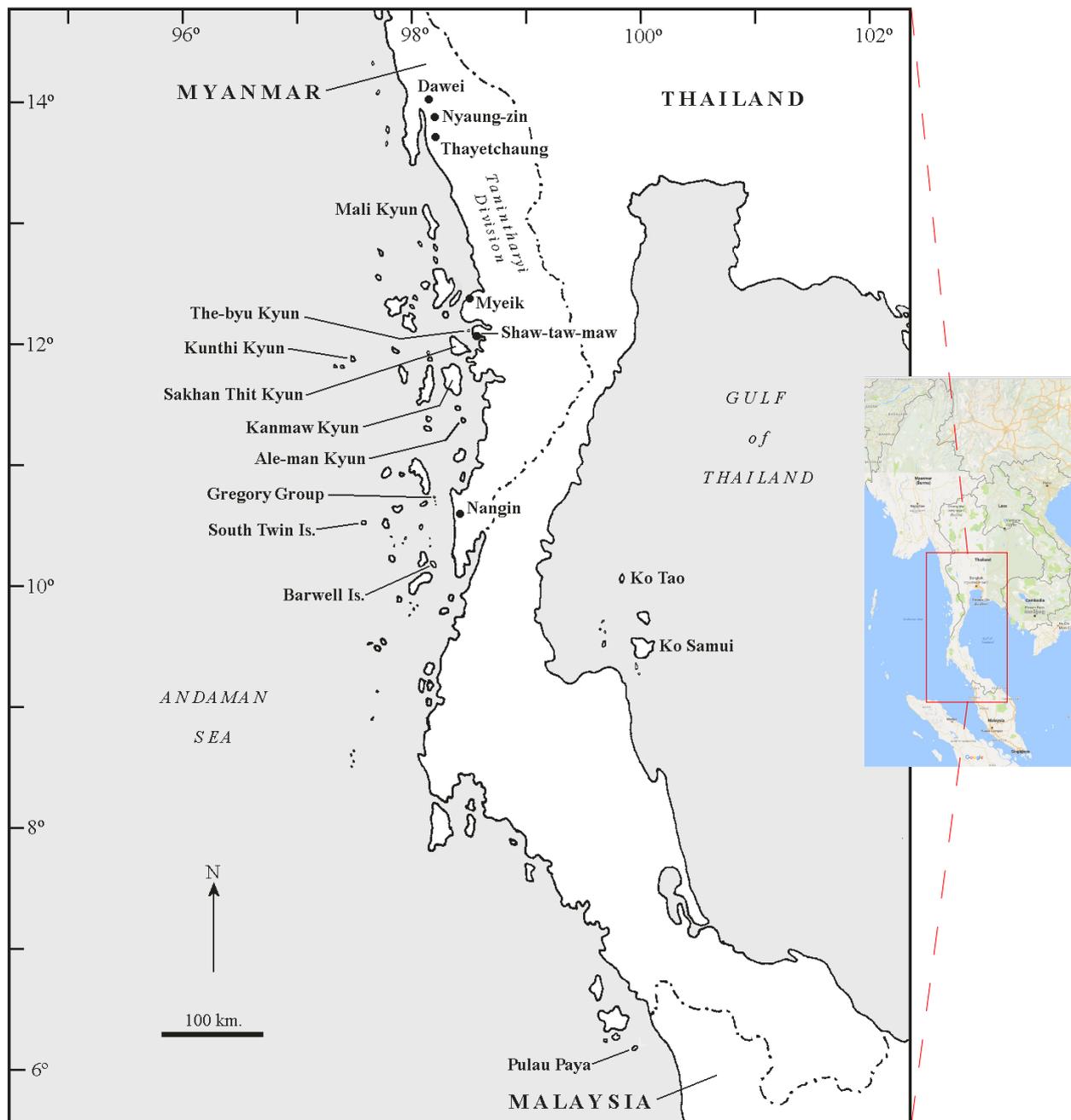


Figure 1. Mainland localities and islands mentioned in the text and in Miller (1903), Wroughton (1915), and Lindsay (1926). *Kyun* = island.

terrestrial ecoregion IM0132 (Myanmar Coastal Rain Forests), where the principal vegetation comprises tropical and subtropical moist broadleaf forests ([www.worldwildlife.org\(1\)](http://www.worldwildlife.org(1))). Shaw-taw-maw and The-byu Island are located in the Critical/Endangered terrestrial ecoregion IM1404 (Myanmar Coast Mangroves). Elsewhere in this ecoregion (notably the Ayeyarwady Delta), the mangrove systems are some of the most degraded in the Indo-Pacific ([www.worldwildlife.org\(2\)](http://www.worldwildlife.org(2))). The mangrove systems in the coastal areas near Shaw-

taw-maw, however, remain relatively intact (Khin Swe Oo, pers. obs.).

Myeik enjoys a tropical monsoon climate with a minimum annual temperature range of 21.0°C (December) to 24.6°C (June) and a maximum annual temperature range of 28.8°C (August) to 33.6°C (April). Average monthly precipitation ranges from 4mm in January to 868mm in August. The winter dry season occurs from November to March while the monsoon season lasts from May to October with maximum

precipitation occurring in June, July, and August (N.O.A.A. 1990).

## MATERIALS AND METHODS

Direct observation of Flying Fox colonies in Myeik took place twice per month from March to October 2016. In Nyaung-zin, observations were undertaken once per month during the months of May, July and September 2016. On each visit, data were collected on roosting behaviour, ecology (with particular reference to the species of roost tree) and threats to the bats and their habitat. Bats were observed through tripod-mounted and hand-held binoculars and population sizes were recorded using a manual hand counter. Observations took place at 10:00hrs and between 14:00hrs and 18:00hrs.

These data were augmented by gathering information from local people. This was achieved through direct enquiry and the distribution of questionnaires, which were collected and analysed upon completion. People were asked to describe their attitudes to the bats and to provide historical data on Flying Fox populations in the immediate and wider areas. They were also asked if they were aware of the role that Fruit bats play in the pollination of plants and the dispersal of seeds.

A single specimen of *P. h. geminorum* was found dead and there was evidence that the bat had been shot. The specimen was prepared scientifically at Myeik University, where it is retained as a wet specimen in 70% formalin with skull extracted.

External, cranial and dental measurements were taken from the specimen: these are listed in Table 1 and are defined as follows: HB - head and body length; HF - hind foot length; FA - forearm length; E - ear length; GTL - greatest length of skull; CBL - condylo-basal length; CCL - condylo-canine length; ZB - zygomatic breadth; BB - breadth of braincase; C-M<sup>2</sup> - maxillary tooththrow length; C-M<sub>3</sub> - mandibular tooththrow length; M - mandible length.

## RESULTS

### New material

*Pteropus hypomelanus geminorum* Miller, 1903: 60. 1 male (adult), MU/150709001, 09.vii.2015, Myeik (12.43836389 N & 98.59722222 E), Tanintharyi Region, Myanmar, collected by Hsu Lae Win. IUCN status (as *P. hypomelanus*): Least Concern (2008).

### Diagnosis

*Pteropus hypomelanus geminorum* can be distinguished from the other two pteropodid taxa known to occur in peninsular Myanmar by its forearm length: the measurement is markedly shorter in *P. geminorum* than in either *P. intermedius* or *P. vampyrus* (Table 1). In the Myeik Archipelago, different colour forms of *geminorum* are present. Andersen (1912) refers to two colour phases, a black-bellied phase and a lighter, brown-bellied phase. Within his description of the black-bellied phase, however, he refers also to a specimen that is "rather brighter, nearly cinnamon-rufous". Of the brown forms of *geminorum*, the darker phase is characterised by a dark brown back and head, a deep chestnut mantle, and blackish underparts. In the lighter form, the belly is not as dark. Specimen number MU/150709001 is consistent in appearance with the latter, lighter form (Image 1).

### Description

In specimen number MU/150709001, the back and flanks are a greyish-brown and the rump is grey. The mantle is dark brown, becoming paler in the mid-dorsal region. The crown of the head is fawn and the throat and sides of the neck are black. On the ventral surface, the breast is brown and the belly is fawn-coloured (Image 1). The forearm length is 135.0mm.

The skull and teeth of the Myeik specimen, which are essentially similar to those of other forms of *hypomelanus* from elsewhere in the species' range (cp. *P. h. annectans* and *P. h. canus*), correspond to the description given in Bates & Harrison (1997).

The skull length (62.5mm) of MU/150709001 falls marginally outside the skull length range (64.7–68.7 mm) of four paratypes of *geminorum* from South Twin Island given by Andersen (1912) and is notably shorter in length than the type of *P. intermedius* from Kyaikkami and specimens of *P. vampyrus* from localities in South-east Asia (Table 1).

In the dentition, the maxillary and mandibular tooththrow lengths are fractionally below the range of *geminorum* from South Twin Island, the latter very marginally so. Both measurements are appreciably below those of the type of *intermedius* and specimens of *vampyrus*.

The mandible length is markedly shorter than in both *intermedius* and *vampyrus*. It is also below the range of the four *geminorum* paratypes from South Twin Island but is not so far removed from the values of the latter specimens as to be inconsistent therewith.

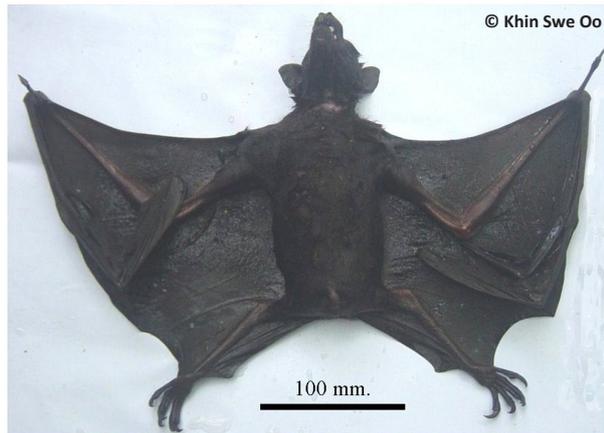


Image 1. Ventral aspect of specimen no. MU/150709001.



Image 2. Roost trees (arrowed) adjacent to a government building in Myeik's civic centre. Sporadic burning of dead vegetation was noted to take place in the rear yard.

Table 1. Selected external, cranial, and dental measurements (in mm.) of specimen no. MU/150709001 from Myeik, *Pteropus hypomelanus geminorum* from South Twin Island, *Pteropus intermedius* from Kyaikkami (Amherst), and *Pteropus vampyrus* from Indonesia, Malaysia, Singapore, and Thailand.

	MU/150709001	Andersen (1912)		Andersen (1912)		Andersen (1912)	
						Bates & Harrison (1997)	
		<i>P. h. geminorum</i>	<i>n.</i>	<i>P. intermedius</i>	<i>n.</i>	<i>P. vampyrus</i>	<i>n.</i>
		(Paratypes)		(Type)			
HB	180.0					259.0-300.0	2
HF	35.5					44.0-65.0	4
FA	135.0	134.0-137.0	4	179.5	1	195.0-209.0	2
E	24.0					28.0-57.0	3
GTL	62.5	64.7-68.7	4	72.5	1	75.0-86.5	3
CBL	59.5					69.0-73.2	2
CCL	55.1						
ZB	32.5					35.8-50.0	5
BB	23.6					25.6-28.5	5
C-M <sup>2</sup>	24.2	25.0-26.2	4	27.0	1	26.3-33.8	4
C-M <sub>3</sub>	27.1	27.2-28.2	4	30.0	1	29.3-37.0	4
M	48.5	51.0-53.7	4	57.0	1	54.4-68.0	5

**Roost tree species**

Flying Foxes were observed roosting in 11 species of tree, comprising 10 genera and eight families, throughout the study area. Details of the trees, including their common and local names, are given in Table 2.

**Distribution and ecology of Flying Fox colonies**

**Myeik:** Flying Foxes were noted to roost throughout the central, arboreal area of the town in the following six species of tree: *Albizia saman* (n=6); *Ficus glomerata* (n=1); *Xylocarpus dolabriformis* (n=2); *Artocarpus heterophyllus* (n=1); *Ficus benghalensis* (n=1); and *Terminalia bellerica*

(n=1). The number of bats and the roost trees selected varied in each month from March to October. Two-hundred individual Flying Foxes were recorded in March, 100 in both April and May, 850 in June, 2605 in July, and 2740, 2500, and 2030 in August, September, and October, respectively (Table 3).

In Myeik, local people indicated that Flying Foxes had been roosting in rain trees (*Albizia saman*) for 50 years and in cluster fig trees (*Ficus glomerata*) for two years. The villagers said that the bats migrated annually. Win (2016) reported that in December, Flying Foxes in Myeik appeared to migrate to other regions for about

**Table 2. Tree species that were observed to support Flying Fox roosts within the study area.**

Family	Species	Common name	Local name
Arecaceae	<i>Areca catechu</i>	Betel nut palm	Kun-thee
Bombacaceae	<i>Durio zibethinus</i>	Durian	Duyin
Combretaceae	<i>Terminalia bellerica</i>	Beleric myrobolan	Thit-seik
Dipterocarpaceae	<i>Shorea</i> sp.		
Euphorbiaceae	<i>Hevea brasiliensis</i>	Para rubber tree	Kyet-paung-see
Meliaceae	<i>Sandoricum koetjape</i>	Santol tree	Thit-to
Mimosaceae	<i>Albizia saman</i>	Rain tree	Kokko
Mimosaceae	<i>Xylia dolabriformis</i>	Burmese ironwood	Pyin-ka-doe
Moraceae	<i>Artocarpus heterophyllus</i>	Jackfruit	Pein-ne
Moraceae	<i>Ficus benghalensis</i>	Banyan	Pyi-nyaung
Moraceae	<i>Ficus glomerata</i>	Cluster fig	Ye-tha-phan

**Table 3. The number of Flying Foxes recorded on roost trees in Myeik.**

Tree species	n	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
<i>Albizia saman</i>	6	0	0	0	500	1690	2050	2000	1700	7940
<i>Ficus glomerata</i>	1	200	100	100	200	450	300	300	300	1950
<i>Xylia dolabriformis</i>	2	0	0	0	150	125	100	50	20	445
<i>Artocarpus heterophyllus</i>	1	0	0	0	0	150	100	50	0	300
<i>Ficus benghalensis</i>	1	0	0	0	0	100	100	50	0	250
<i>Terminalia bellerica</i>	1	0	0	0	0	90	90	50	10	240
Total	12	200	100	100	850	2605	2740	2500	2030	11125

one month, returning in January.

All the trees in which Flying Fox colonies were observed were located adjacent or close to local government buildings (Image 2) within Myeik's civic centre, which lies 250m inland from the coast. The civic centre encompasses an area of approximately 0.025km<sup>2</sup>.

All Flying Foxes observed in Myeik town appeared morphologically similar and, in the absence of information to the contrary, it is considered that all are assignable to *P. h. geminorum*. Bats of the brown colour phase were seen together in the same roost with individuals that corresponded more closely with the cinnamon rufous form mentioned by Andersen (1912) (Image 3).

**Nyaung-Zin village:** Flying Foxes were observed roosting in 31 trees, all of which were located in the compound of Kyaung-gyi monastery. Five species of tree were represented: *Durio zibethinus* (n=8); *Hevea brasiliensis* (n=10); *Shorea* sp. (n=4); *Areca catechu* (n=5); and *Sandoricum koetjape* (n=4). The number of Flying Foxes and the roost trees selected varied in each of the three months in which surveys took place. Four-hundred-and-forty-one individuals were recorded in

May, 630 in July, and 550 in September (Table 4).

Villagers stated that Flying Foxes were present in Dawei District throughout the year. Local reports suggested that the bats roosted in the compound of Tauk-htein Taung monastery in the Yan-taung area of Thayetchaung Township (Fig. 1) and migrated to the compound of Kyaung-gyi monastery in Nyaung-zin village during the summer rainy season. Thayetchaung Township lies 24km south of Dawei and the distance from Tauk-htein Taung monastery to Kyaung-gyi monastery is 13km.

At Kyaung-gyi monastery, Flying Foxes were noted to mate in July.

The Flying Foxes observed at Nyaung-zin appeared to differ in their external appearance from the bats observed in Myeik. The Nyaung-zin Flying Foxes seemed morphologically similar to each other, differing only in the colour of the dorsal and ventral pelage, the latter varying from mid-brown in some bats to light orange tan in others (Image 4). Pending the collection of actual specimens from Nyaung-zin, the bats' taxonomic status remains uncertain.

**Shaw-Taw-Maw:** Information gathered from local



Image 3. A colony of *Pteropus hypomelanus geminorum* in Myeik showing brown and “cinnamon rufous” colour forms together.



Image 4. Photograph of a single Flying Fox from a colony of *Pteropus* sp. at Kyaung-gyi monastery in Nyaung-zin village. The ventral pelage of individual bats varied from light orange tan (above) to mid-brown.

Table 4. The number of Flying Foxes recorded on roost trees in Nyaung-zin.

Tree species	n	May	Jul	Sep	Total
<i>Durio zibethinus</i>	8	100	210	300	610
<i>Hevea brasiliensis</i>	10	100	100	180	380
<i>Shorea</i> sp.	4	125	150	15	290
<i>Areca catechu</i>	5	75	100	35	210
<i>Sandoricum koetjape</i>	4	41	70	20	131
Total	31	441	630	550	1621

people indicated that Flying Foxes roosted only during the rainy season (May–October). The number of Flying Foxes was considered to be about 1,000 and these were observed roosting in santol trees (*Sandoricum koetjape*). Flying Fox roosts were reported to have been present for 30 years.

**The-Byu:** Flying Foxes were reported by villagers to roost in santol trees on the hillsides of this small island. According to the information provided, the bats roosted only during the rainy season, after which they migrated. The colony was considered to number several thousand individuals.

Both at Shaw-Taw-Maw and on The-Byu island, insufficient information was gathered to enable the bats’ taxonomic identities to be determined.

**Threats**

In Myeik, Flying Foxes are reported to be hunted for food by local people, who will usually shoot the bats. The extent of this practice could not be determined, but the bodies and wings of two dead bats found during the course of the survey showed evidence of gunshot

penetration.

After heavy rains, one Flying Fox was found dead attached to overhead power lines. It seemed likely that the bat had been electrocuted and this may have been caused by incomplete insulation of the cables or by the conduct of electricity by water along sheathed cables from poorly insulated sections. It was noticeable that the bat’s left and right wings were touching separate cables. Bats will not suffer electrocution if they come into contact with a single energised cable but will suffer a severe adverse reaction from the electrical current if they come into contact with two energised wires simultaneously (Agwanda 2013). Such contact is made usually by the wing membrane and this was the case with the individual found on the power lines at Myeik. It was not uncommon during the survey to find dead Flying Foxes beneath power lines following periods of heavy rainfall.

Burning of dead vegetation was noted to take place beneath a roost tree in the yard of a government building in Myeik (Image 2) but this is considered to be a short-term event and to pose no ongoing threat to the bats’ habitat.

At Nyaung-zin, no threats to the Flying Fox colonies were evident. It was learnt that the monks at Kyaung-gyi monastery prohibit the hunting or shooting of the Flying Foxes present in the compound and that burning of materials does not take place within the monastery’s

grounds.

At Shaw-taw-maw and on The-byu island, local people did not identify any threats to the Flying Fox colonies or their habitats. It may be the case that there are no perceivable threats or that existing threats were not reported.

## DISCUSSION

Prior to the current survey, *Pteropus hypomelanus geminorum* was known in Myanmar only from the type locality of South Twin Island (Mickleburgh et al. 1992) and from Sir John Hayes Island (Kunthi Kyun) (Lindsay 1926) in the Myeik Archipelago (Fig. 1). The collection of the taxon from Myeik town represents the northernmost record of the subspecies and is the first documentation of *P. h. geminorum* from a mainland site.

South Twin Island lies 240km south-south-west of Myeik and 87km west of the nearest mainland coast at Nangin while Kunthi Kyun is located 115km south-west of Myeik and 94km from the nearest point on the mainland, just to the south of Sakhan Thit Kyun (Sellore Island) (Fig. 1). Between these four points lie more than 100 islands, islets, and island groups, many of which offer very similar habitats to that found on South Twin and Kunthi Kyun. It is not improbable, therefore, that further insular colonies of the taxon would be found if these islands were surveyed for the purpose. Naturally, it would be useful for coastal areas of the mainland (initially between Myeik and Nangin) to be assessed similarly and this would address the recommendation of Mickleburgh et al. (1992) that surveys be undertaken to provide further information on the status of *P. h. geminorum*.

The distribution of *P. hypomelanus* is greater than other *Pteropus* species (Jones & Kunz 2000) but it has rarely been reported from mainland areas. It is known from islands along the east and west coasts of the Malay Peninsula but not from the Peninsula, itself. It has been reported from the mainland of Papua New Guinea but its occurrence there is rare, the species being found in much greater numbers on the islands off the country's north coast (Jones & Kunz 2000).

Flying Foxes are known to fly significant distances with individuals of the Grey-headed Flying Fox *Pteropus poliocephalus* having been recorded travelling 500km within 48 hours (Roberts et al. 2012) while *Pteropus vampyrus* has been reported covering 363km in 96 hours (Epstein et al. 2009). Elsewhere in its range, *P. h. geminorum* is known only from the islands of Ko Samui

and Ko Tao in Thailand (16km and 64km distant from the mainland, respectively) and Pulau Paya in Malaysia (27km from the mainland) (Mickleburgh et al. 1992) (Fig. 1).

Although essentially an urban environment, it may be the case that the tree species and food sources and their abundance are sufficiently similar in Myeik Town to South Twin Island and Kunthi Kyun to provide *P. h. geminorum* with the habitat it favours but the general preference of *P. hypomelanus* and other *Pteropus* species (e.g., *Pteropus voeltzkowi*) for insular habitats and their ostensible disinclination to travel distances to mainland sites that are well within their flight capability requires further research.

Of the 12,746 observations of individual Flying Foxes throughout the study area, 62.3% of bats (7,940 observed individuals) were noted to roost in rain trees (*Albizia saman*), 15.3% (1,950) in cluster fig trees (*Ficus glomerata*), 4.7% (610) in durian trees (*Durio zibethinus*), 3.5% (445) in Burmese ironwood trees (*Xylocarpus dolabriformis*), 3% (380) in Para rubber trees (*Hevea brasiliensis*), 2.4% (300) in jackfruit trees (*Artocarpus heterophyllus*), 2.3% (290) in *Shorea* sp., 2% (250) in banyan trees (*Ficus benghalensis*), 1.9% (240) in beleric myrobolan trees (*Terminalia bellerica*), 1.6% (210) in betel nut palms (*Areca catechu*), and 1% (131) in santol trees (*Sandoricum koetjape*). In respect of the last species, however, unconfirmed reports from local people state that significant numbers of Flying Foxes roost in santol trees in Shaw-taw-maw and on The-byu island. To determine whether the bats' roost tree preferences are similar to the percentages shown, it would be helpful to undertake an assessment of the available roosting space in each tree species within the study area.

Old World Fruit bats play an important part in the pollination of plants and the dispersal of seeds (Aziz et al. 2016) but in their responses to questionnaires, many of the inhabitants of Myeik indicated that they were unaware of this. A simple education programme aimed at informing the local townspeople of the beneficial role Flying Foxes play in the ecosystem and of the consequent need to protect the bats and their habitat might reasonably be expected to reduce the threats posed to the colonies of *P. h. geminorum*, particularly that of hunting. Such a programme would be consistent with the recommendation of Mickleburgh et al. (2009), who advocate more education projects to reduce hunting pressure. *Pteropus hypomelanus* is known to be hunted for its meat in Malaysia, New Guinea, and the Philippines (Mickleburgh et al. 2009) and in Thailand (Mildenstein et al. 2016).

In the case of the electrocution of bats on overhead power cables, it has been recommended elsewhere that cables be spaced at a distance from each other that is greater than the wingspan of smaller, non-pteropodid species (>60cm) to prevent the wingtips from coming into contact with two cables simultaneously (Agwanda 2013). Whilst this can be an appropriate solution in respect of non-pteropodid species, it may prove unworkable with regard to Flying Foxes as the cables would need to be spaced so far apart (the wingspan of *P. vampyrus* can reach 1.5m (Kunz & Jones 2000)) as to make construction of overhead power networks impractical. A simpler solution would be to ensure that all energised cables are securely insulated (Agwanda 2013).

Mickleburgh et al. (1992) classified *P. h. geminorum* as data deficient and recommended that surveys take place to assess its status. Since the date of that publication, little research has been undertaken and there remains considerable scope for further study of this under-evaluated taxon.

## RECOMMENDATIONS

In order to augment current information on the ecology of Flying Foxes in Tanintharyi Region and to promote their conservation, we would make the following recommendations:

- To determine the taxonomic identity of the Flying Foxes present at Nyaung-zin and to undertake a genetic analysis of this colony and of the population of *P. h. geminorum* in Myeik Town.
- To carry out surveys to determine the presence and population status of Flying Fox colonies on the islands of the Myeik Archipelago.
- Following the study of the diet of *Pteropus giganteus* in Upper Myanmar by Win & Mya (2015), to undertake similar research in respect of the diet of *P. h. geminorum* in Myeik.
- To use radio-tracking equipment to plot both the nightly and seasonal migration of Tanintharyi's Flying Foxes in order to locate foraging areas and to determine which areas are threatened by deforestation.
- To conduct a simple education programme amongst the local people of Myeik Town to explain the ecosystem services provided by Flying Foxes and the consequent need to conserve the bats and their habitats.

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[www.worldwildlife.org\(2\)](http://www.worldwildlife.org(2)) – see <https://www.worldwildlife.org/ecoregions/im1404>

Myanmar Abstract:

မြန်မာနိုင်ငံ၊ တနင်္သာရီတိုင်းဒေသကြီး၊ မြိတ်ခရိုင်၊ မြိတ်မြို့နယ်၊ ထားဝယ်ခရိုင်၊ ညောင်စင်ကျေးရွာတို့တွင် အိပ်တန်းခွဲ၊ နေထိုင်လျက်ရှိသော သီးစားလင်းဆွဲမျိုးစိတ်များအား ၂၀၁၆ ခုနှစ်၊ မတ်လနှင့် အောက်တိုဘာလအတွင်းတွင် ကွင်းဆင်းလေ့လာခဲ့ပါသည်။ မြိတ်မြို့အတွင်းတွင် ၁၂ နေရာ အိပ်တန်းခွဲ၊ နေသည့်မျိုးစိတ်မှာ *Pteropus hypomelanus geminorum* ဟု မှတ်ယူနိုင်ကြောင်းကို တစ်ကောင်တည်းသာရရှိထားသော လင်းဆွဲကိုစံနမူနာထား မျိုးခွဲနိုင်ခဲ့ပါသည်။ ၎င်းမှာ ပထမဆုံးသော ကုန်းတွင်းပိုင်းတွေ့ရှိမှုအဖြစ် မှတ်တမ်းတင်နိုင်ခဲ့ပါသည်။ ဒေသခံများ၏ပြောကြားချက်များအရ ကမ်းရိုးတန်းရှိ ရွှေတောင်မော်ရွာနှင့် စခန်းသစ်ကျွန်းအနီးရှိကျွန်းငယ်တစ်ခုဖြစ်သော သဲဖြူကျွန်းတို့တွင်လည်း လင်းဆွဲများကိုတွေ့ရှိတတ်သည်တောင်းများကို ထပ်မံကြားသိထားရပါသည်။ ယခုလေ့လာတွေ့ရှိချက်မှာ လင်းဆွဲများအုပ်စုလိုက်အိပ်တန်းခွဲ၊ နေထိုင်လျက်ရှိသောနေရာများ၊ ဒေသခံများ၏မြောက်လှန်၊ ဟန့်တားမှုများနှင့် ၎င်းတို့နေထိုင်သောအပင်မျိုးစိတ်များကို မှတ်တမ်းတင်ထားခြင်းဖြစ်ပါသည်။





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