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Fruit bats trade in the traditional markets of South Minahasa, North Sulawesi, Indonesia

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[2]Faculty of Fisheries and Marine Science, Universitas Sam Ratulangi. Jl. Bahu, Malalayang, Manado 95115, North Sulawesi, Indonesia
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Abstract. *Ransaleleh TA, Kawatu M, Wahyuni I, Onibala J, Nangoy MJ, Umboh S, Rembet UNWJ, Saputro S, Wiantoro S. 2024. Fruit bats trade in the traditional markets of South Minahasa, Sulawesi, Indonesia. Biodiversitas 25: 716-725.* The hunting and trading of fruit bats are significant sources of income for several communities in North Sulawesi, Indonesia. Therefore, this research aimed to map the market locations and identify the species of traded bats, along with their conservation status in South Minahasa District. Surveys of markets, hunters, and sellers were conducted for 5 months from May to September 2023. Morphological examinations were carried out on the traded bats, focusing on several parameters such as body weight, morphometric and description of the morphological characters. We identified the traditional markets which sell fruit bats (family Pteropodidae), *Acerodon celebensis* and *Pteropus alecto* meat, namely Berdikari Tumpaan, 54 Amurang, 45 Langsot Tareran, Tenga, Pakuure, Ongkaw, Soko Raanan Baru, Motoling, Poigar, Poopo, Pinaesaan Tompaso Baru, and Pinasungkulan Modoinding. Furthermore, two markets, namely Pakuure and Pinaesaan Tompaso Baru, were identified selling the small fruit bats (family Pteropodidae), *Cynopterus minutus, Dobsonia exoleta, Nyctimene cephalotes, Rousettus amplexicaudatus,* and *Thoopterus nigrescens*. According to the International Union for Conservation of Nature (IUCN) Red List, *A. celebensis* and *D. exoleta* are endemic bat species in Sulawesi with a conservation status of vulnerable and least concern, respectively. Fostering education and advocacy program is crucial to promote awareness and conservation strategy, especially for the 12 traditional markets which trade seven fruit bat species in South Minahasa, Sulawesi.

Keywords: Bats, conservation, Sulawesi, trade, traditional markets

INTRODUCTION

Bats are widely recognized as pollinators, seed dispersers, a food source for some communities (Mickleburgh et al. 2009; Friant et al. 2015; Mildenstein et al. 2016; Suwannorang and Schuler 2016; Akem and Pemunta 2020; Baqi et al. 2021). Additionally, bats are used as objects in biomedical research, particularly in relation to global public health issues including cancer (Periasamy et al. 2019) and diseases caused by viruses (Wang et al. 2018; Benerjee et al. 2019; Wang et al. 2021). In Sulawesi, the exploitation of fruit bats in their natural habitats has increased due to the high demand for meat, specifically during Christian religious holidays such as Easter, Thanksgiving, Christmas, and New Year, with well-organized trade routes (Latinne et al. 2020). In the traditional markets and supermarkets, traded bats which predominantly consisting of flying foxes are sourced from the collector or middle man who gather the bats from hunters in Gorontalo, Central Sulawesi, West Sulawesi, South Sulawesi, and Southeast Sulawesi (Sheherazade and Tsang 2018; Ransaleleh et al. 2020; Latinne et al. 2020). Meanwhile, the trade of small fruit bats originates from around North Sulawesi, specifically Minahasa and Bolaang Mongondow. Based on observations from 2011-2022, trading activities in North Sulawesi are concentrated in the traditional markets including Bolaang Mongondow (Ransaleleh et al. 2020), Manado, Tomohon, Minahasa Induk, South Minahasa, and several supermarkets in Manado (Ransaleleh et al. 2013; Latinne et al. 2020).

Bats have played a central role in the emergence of various viral diseases trough the unwanted forced interactions among species (Galindo-González 2023). Other than improper bat handling, one of the implicated risk factors is ingestion of bat meat, soup or other dishes made from bat (Gupta et al. 2021). Despite the widespread discussion regarding bats and their roles in the context of the COVID-19 pandemic as potential disease reservoirs (Koch et al. 2020), a post-pandemic survey conducted by a research team from Sam Ratulangi University and National Research Agency (BRIN) from 2021 to early 2023 (unpublished) shows that the hunting of small fruit bats in South Minahasa and Bolaang Mongondow Regencies has intensified due to market demand. Some sellers even have freezers as storage for bats and other wild animals obtained from hunters.

Based on the preliminary research, South Minahasa has more traditional markets which trade the wild animals compared to Minahasa Induk, Tomohon, and Manado. While data of the population of fruit bats in Sulawesi is currently lacking and most of them are officially unprotected species, there is an increasing concern that the species hunted for consumption will experience decline and potentially face extinction. This significant reduction is due to the slow reproductive rate of flying foxes, which give birth once a year to only one offspring (Ransaleleh et al. 2022), while very few species of small fruit bats reproduce twice a year (Bumrungsri et al. 2006). Considering the ecological function of bats as seed dispersers and pollinators of economically valuable plants (Sheherazade et al. 2019; Tremlett et al. 2020; Shah et al. 2021), efforts are needed to ensure their sustainability in the wild. Conservation and captivity (Frick et al. 2020; Ransaleleh et al. 2021; Ransaleleh et al. 2022) are necessary for their long-term survival. In addition to this effort, knowledge about the species, information of the traded bats, and their habitat distribution is crucial for developing conservation program or other intervention from the relevant stakeholders (Kingston 2010; Frick et al. 2020; Rocha et al. 2020). Despite the traded bats in the traditional markets of South Minahasa is the biggest markets in North Sulawesi, detailed information has never been scientifically reported. Therefore, this research aimed to map the market locations and identify the species of traded bats in South Minahasa, along with their conservation status.

MATERIALS AND METHODS

Research area

This research was conducted in the 13 traditional markets of South Minahasa, as shown in Figure 1. These included Berdikari Tumpaan (A), 45 Langsot Tareran (B), 54 Amurang (C), Bohusami Sapa Timur (D), Tenga (E), Pakuure (F), Ongkaw (G), Soko Raanan Baru (H), Motoling (I), Poigar (J), Poopo (K), Pinaesaan Tompaso Baru (L), including Pinasungkulan Modoinding (M).

Data collection and analysis

The preliminary survey was conducted in April 2023 to confirm market days and establish initial communication with bat sellers, including hunters at each research location. The data were collected once a month from May to September 2023, comprising two sessions before (May-June), one session during (July), and two sessions after Thanksgiving (August-September). The moment of thanksgiving is crucial for doing the bat trade survey, since usually the trading of fruit bats increases because of the demand from consumer. Historically, thanksgiving or *pengucapan syukur* in Minahasa is one of the old traditions to celebrate the rice and clove harvesting. Recently, the local government of South Minahasa defined thanksgiving will be celebrated during the anniversary of this regency, which is in July.

To ensure the diversity of traded bats which were mostly in dead condition, samples of small fruit bats sourced from hunters and sellers in the traditional markets were selected based on different physical features. These bats were placed in black bags for body weight measurement, observation, morphological examination and morphometric measurement. For flying foxes, observations were limited to morphological description and body weight measurement, which was conducted by thawing the frozen bats and drying their fur. Morphometric measurement was not performed to avoid bias since the bats were sold frozen. Each observed species was documented using a camera for further identification when needed. The morphometric variables measured included the length of the body, head, forearm, ear, tibia, hind foot, and tail (Wiantoro et al. 2016). A total of 262 small fruit bats comprising five species were used, originating from four markets, namely Pakuure, Tenga, Pinaesaan Tompaso Baru, and Pinasungkulan Modoinding. Additionally, 288 flying foxes comprising two species were randomly selected for the description of morphological characters and body weight measurement. All collected data were then tabulated, interpreted, and narrated descriptively.

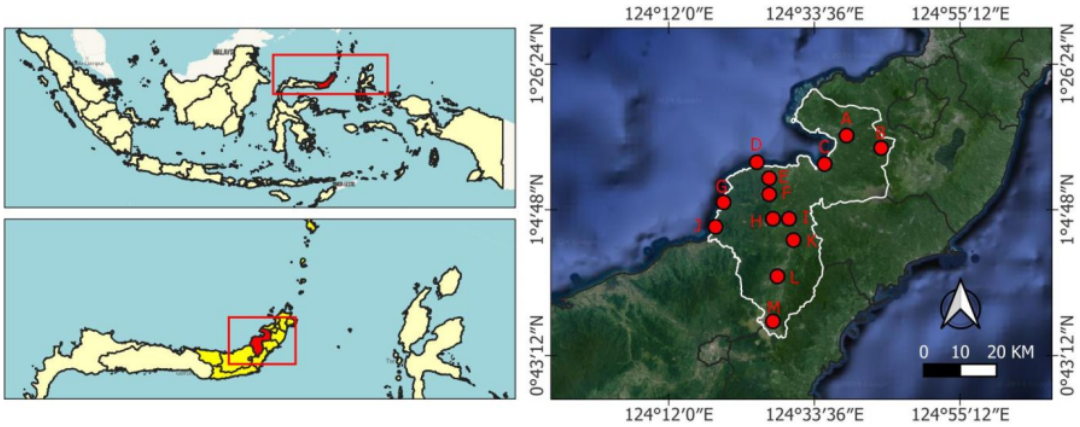

Figure 1. Location of wet markets in South Minahasa District, North Sulawesi, Indonesia. See text for A to M

RESULTS AND DISCUSSION

Traditional markets which trade the bats in South Minahasa

The observation conducted in South Minahasa indicated that only one out of 13 operating traditional markets did not sell wild animal meat, specifically bats, namely Buhusami Sapa Timur, as shown in Figure 2. Eight of them mainly sell flying foxes (*A. celebensis* and *P. alecto*), while four markets also sell the small fruit bats.

45 Lansot Tareran Market

The market located in the sub-district capital, Tareran Village, South Minahasa District, operates on Mondays, Wednesdays, and Fridays, from 07:00 am to 01:00 pm. The wild animal meat sold in this market included forest rats, snakes, wild boars, and bats, with various species such as the black flying fox (*P. alecto*) and the Sulawesi flying fox (*A. celebensis*), obtained from wild animal meat collectors. Bat meat sellers are not only from local communities but also come from Kawangkoan and Tumpaan, who relocated based on market opening hours. The number of bat meat sellers ranges from four individuals during Thanksgiving and only one to two individuals before and after the celebration. On festive days approaching Thanksgiving, the sellers not only sell bats in the market but also have stock stored in freezers at their respective homes. Bat meat is not always available every day after and before Thanksgiving, but there are remains from the sales in the first week following the celebration. The price in May and June (before) as well as August and September (after) in South Minahasa ranges from IDR 65,000-70,000/kg, increasing to IDR 95,000/kg for Thanksgiving in July. Visitors to this market come from Lansot and Rumoong Langsot, Lapi, Wuwuk, Taraitak, Tumaluntung, and Koreng.

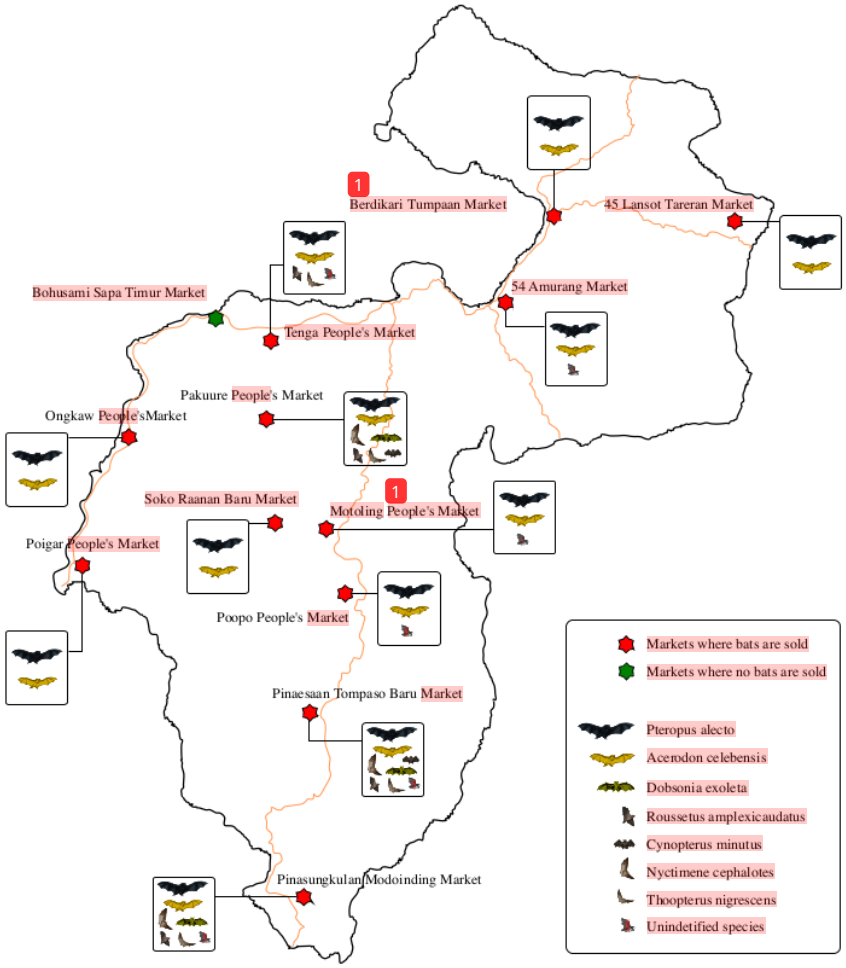

Figure 2. Traditional markets with the bat trade in South Minahasa District, North Sulawesi, Indonesia

Berdikari Tumpaan Market

The market is located in Tumpaan Village the capital of Tumpaan Sub-district, South Minahasa District, North Sulawesi Province, opening every day from morning to afternoon. Furthermore, it experiences increased activity, particularly bustling with visitors on Saturdays and Sundays. Some sellers of wild animal meat in this market also sell the same species in the 45 Lansot Tareran market. The number of bat meat sellers ranges from three to six individuals each day. Compared to the 45 Lansot Tareran Market, bat meat at Berdikari Tumpaan Market is always available, including wild boars, forest rats, monitor lizards, and snakes. The price of bat meat on market days is usually IDR 70,000/kg but reaches IDR 90,000/kg on certain festive days such as Thanksgiving, with a sale ranging from 10 to 50 individuals. Similarly, this market is very busy with visitors during Thanksgiving in South Minahasa. Visitors come from Tumpaan and Minahasan restaurant owners selling wild animal meat dishes along the Amurang-Manado road, from Maruasey, Lelema, Tareran, and Ranomea.

54 Amurang Market

The market is located in Uwuran Satu Village, Amurang Sub-district, South Minahasa District, North Sulawesi Province, opening every day from morning to afternoon. Meanwhile, bat meat sellers ranging from three to eight bats operate only until around noon at 12:00 pm. The quantity of bat meat sold is higher compared to Berdikari Tumpaan and 45 Lansot Tareran Markets. The species sold include *P. alecto, A. celebensis*, and others that cannot be identified due to being already grilled. The quantity of *P. alecto* and *A. celebensis* sold by each seller ranges from 50 to 150 bats. The price is not significantly different from 45 Lansot Tareran and Berdikari Tumpaan Markets, both on regular and days during Thanksgiving. However, unsold bats are taken back home by the sellers and sold again in the same market the next day. Based on observations, most sellers sell wild animal meat, including bats, at the market and also promote their sales through social media, specifically on Facebook. This expands their customer base beyond local communities and restaurant owners in South Minahasa, thereby attracting communities from various cities and regencies, including Manado. Direct interviews with several buyers in this market showed the ability to purchase bat meat for Thanksgiving preparations, personal birthdays, wedding anniversaries, catering businesses, daily meals for the family, and other celebratory events. Some Minahasan restaurant owners even buy bat meat as a stock against the decrease in market supply and higher prices.

Tenga People's Market

The market is located in Tenga Village, the capital of Tenga Sub-district, South Minahasa District, North Sulawesi Province, opening every Monday, Wednesday, and Friday from morning to afternoon. The number of wild animal meat sellers ranges from two to six individuals, with only two to three selling bat meat. These sellers consist of two individuals selling *P. alecto* and *A. celebensis* from Pakuure Village and 1 selling *R. amplexicaudatus* and *T. nigrescens* from Imandi Village, Dumoga Sub-district, Bolaang Mongondow District, North Sulawesi Province. Similar to other markets, the bat price increases from IDR 65,000-70,000 to IDR 85,000-95,000 per kilogram during Thanksgiving. *R. amplexicaudatus* and *T. nigrescens* are sold for IDR 40,000-50,000 per bundle consisting of 6 individuals. Smoked or grilled bats are sold for IDR 50,000 per skewer, consisting of 6 bats, which are not always available on market days. Visitors come from Tenga and Pakuure, Pakuure Satu, Pakuure Dua, Pakuure Tinanian, Pakuure Kinamang, Pakuure Tiga, and Pakuweru.

Pakuure People's Market

The market is located in Pakuure Tinanian Village, Tenga Sub-district, South Minahasa District, North Sulawesi Province, opening every Tuesday and Saturday. The number of wild animal meat sellers in this market is two individuals originating from Pakuure Village. These sellers have similarities with Tenga People's Market, thereby the bat species sold are also the same, with a price range of IDR 65,000 per kilogram to IDR 95,000/kg during Thanksgiving. Although bats are not always available at the market, sellers keep stock in freezers, allowing direct pick-up from homes when needed by buyers. Small fruit bat meat in this market is sold by hunters from Pakuure Village and sellers at Imandi Village, Dumoga Sub-district, Bolaang Mongondow District, North Sulawesi Province. These sellers are not the same as Imandi Village which sells in Tenga People's Market, although showing a similar identity. Hunters from Pakuure and Imandi Village catch bats for family consumption and sell excess directly from house to house or through Facebook social media platform. For online transactions, buyers from Pakuure Village simply place an order and after confirmation, sellers promptly deliver the bats directly at the same price as offered in Tenga People's Market. The species sold in this market include *R. amplexicaudatus, T. nigrescens, N. cephalotes, C. minutus, D. exoleta,* and others that cannot be identified due to being already grilled. These small fruit bats are only available on certain days and are sold for IDR 50,000 per bundle consisting of three to six bats, based on the size of the bats in a bundle. Visitors to this market come from Pakuure Raya and Boyong Atas Villages.

Ongkaw People's Market

The market is located in Ongkaw Satu Village, the capital of Sinonsayang Sub-district, South Minahasa District, North Sulawesi Province, opening on Mondays and Saturdays, with bustling visitors. The number of wild animal meat sellers ranges from two to four, with only one seller specifically offering bat meat, while others are from the neighboring village of Poigar. The bats sold in this market come from collectors in Amurang and the species are the same as 45 Lansot Tareran, Berdikari Tumpaan, 54 Amurang, Tenga, and Pakuure Markets, namely *P. alecto* and *A. celebensis*. Furthermore, the price ranges from IDR 60,000-65,000 to IDR 90,000-95,000 per kilogram during Thanksgiving in July. Based on observations after Thanksgiving, the price remains high at IDR 80,000-85,000 per kilogram to October. In this market, visitors come from

Ongkaw Village, including Poigar, Tanamon, Blongko, Aergale, and Boyong Pante Villages, Sinonsayang Sub-district.

Poigar People's Market

The market is located in Poigar Satu Village, Sinonsayang District, South Minahasa District, North Sulawesi Province, opening on Tuesdays and Fridays. The number of wild animal meat sellers ranges from one to three individuals, consisting of two sellers from Poigar Village and one from Ongkaw Village. The bat species sold are *P. alecto* and *A. celebensis* but are not always available. Bats are only available during Thanksgiving and are not present before and after the celebration. The price of bat meat and the visitors at this market are the same as Ongkaw Market.

Motoling People's Market

The market is located in Motoling Dua Village, Motoling Sub-district, South Minahasa District, North Sulawesi Province, and operates on Thursdays from morning to afternoon every week. The number of wild animal meat sellers, including bats ranges from five to six, moving from one market to another according to the existing market day schedule. The bat species sold are *P. alecto, A. celebensis*, and others that cannot be identified due to being already grilled. This market is significantly large compared to 45 Lansot Tareran, Poigar, Ongkaw, Tenga, and Pakuure Markets in terms of species and the number of animals sold. On average, each seller sells ranging from 30 to 100 bats, while the unsold are brought to other markets around Motoling on different days. Generally, bats are available every market day with a price ranging from IDR 65,000 to 70,000 and IDR 80,000 to 100,000 per kilogram during Thanksgiving in South Minahasa. Based on observations to October, the price of bat meat in this market remains high at IDR 80,000 per kilogram.

Soko Raanan Baru Market

The market is located in Raanan Baru Village, West Motoling Sub-district, South Minahasa District, North Sulawesi Province, opening on Saturdays from morning to afternoon. The number of bat sellers in this market ranges from two to three, each from the local community and Ranomea Amurang Village who also sell at 54 Amurang Market, and Motoling Village selling at Motoling Market, respectively. The species sold are *P. alecto* and *A. celebensis*, with each seller offering around 10-15 bats. On regular market days before Thanksgiving, the price is IDR 70,000 increasing to IDR 95,000 per kilogram during the celebration. After Thanksgiving, bats are not available in this market, only other types of wild animal meat. Visitors come from Raanan Baru, Raanan Baru Satu, Raanan Baru Dua, Tondey, Keroit, and Toyopon Villages.

Poopo People's Market

The market is located in North Poopo Village, Ranoyapo District, South Minahasa District, North Sulawesi Province, opening on Fridays. During Thanksgiving, there are six wild animal meat sellers, including bats, from the Motoling and Tompaso Baru Sub-districts. Meanwhile, the number of sellers is only about three to four before and after the celebration. The bat species sold include *P. alecto, A. celebensis*, and others that cannot be identified due to being grilled. This market is also busy during Thanksgiving, with a variety of wild animal meat available at a higher price compared to regular days. The price of bats varies from IDR 60,000 to IDR 65,000 per kilogram before Thanksgiving and rises to IDR 95,000 per kilogram in July during the celebration. Based on observations to September, the price only decreased to IDR 75,000 per kilogram. Visitors to this market come from Poopo, Pontak, Lompad, and Ranoyapo Villages.

Pinaesaan Tomposo Baru Market

The market is located in Pinaesaan Village, Tompaso Baru District, South Minahasa District, North Sulawesi Province, opening on Tuesdays, Thursdays, and Saturdays, with Saturdays being the busiest. During Thanksgiving, there are 14 wild animal meat sellers, including bats, and the selling locations are not concentrated in one place. The bat species sold are highly diverse, including *P. alecto* and *A. celebensis*, with a price ranging from IDR 85,000 to IDR 100,000 per kilogram. *R. amplexicaudatus, T. nigrescens, N. cephalotes, and C. minutus*, consisting of 5 bats, are sold for IDR 50,000 per bundle, *D. exoleta*. Meanwhile, 2 bats are sold for IDR 75,000 per bundle, and four small smoked bats are sold for IDR 50,000 per bundle. Almost all sellers come from Tompaso Baru and Motoling Sub-districts. *P. alecto* and *A. celebensis* are obtained by sellers from collectors, while *R. amplexicaudatus, T. nigrescens, N. cephalotes, C. minutus, D. exoleta,* and other species are caught by hunters around the forests surrounding villages in Tompaso Baru Sub-district. On regular days, the number of bat sellers is only approximately three to four. Visitors to this market come from Karowa, Kinalawiran, Liandok, Lindangan, Pinaesaan, Raraatean, Sion, Tompaso Baru Satu, and Torout Villages.

Pinasungkulan Modoinding Market

The market is located in Pinasungkulan Village, the capital of Modoinding Sub-district, South Minahasa District, North Sulawesi Province, opening on Mondays, Wednesdays, and Fridays. Furthermore, it is usually during festive seasons, particularly Thanksgiving, consisting of nine wild animal meat sellers, including bats, which reduces to two to three after the celebration. The bat species sold are the same as Pinaesaan Tompaso Baru Market, namely *P. alecto* and *A. celebensis* obtained from collectors, while *R. amplexicaudatus, T. nigrescens, N. cephalotes,* and *C. minutus* are sourced from hunters in Tompaso Baru and Modoinding. The price before and during Thanksgiving in this market is similar to Pinaesaan Tompaso Baru Market. Moreover, visitors to this market come from the Modoinding Sub-district.

The bat species, namely *P. alecto* and *A. celebensis* sold in traditional markets of South Minahasa District are the same as in Manado, Tomohon, Kawangkoan, Langowan, and Bolaang Mongondow before COVID-19. Meanwhile,

small fruit bats sold are similar to Dumoga, Bolaang Mongondow District, and some hunters in South Minahasa District before COVID-19 (Ransaleleh et al. 2013; Ransaleleh et al. 2020; Latinne et al. 2020). Based on direct interviews in a village in South Minahasa, there are 3 to 4 hunters. In this village, hunting activities are carried out at least once a month based on the needs. In 1 hunting session, the captured bats range from 15 to 20, resulting in a monthly catch of about 45 to 60. When hunting is carried out every month, the estimated annual catch would be approximately 540 to 720 bats. In contrast, there are 4 groups of hunters in a village in North Minahasa and hunting activities depend on the fruit season, from July to April, with a daily catch of 15 to 22 bats. When hunting is conducted every month during the fruit season, the estimated annual catch is 600 to 880 bats. This is significantly different from Bolaang Mongondow hunters who hunt 2 to 3 times a month, lasting for 3 to 4 days, capturing hundreds of bats and other wild animals. Despite the laws to protect wildlife against over exploitation, most of bat species in Indonesia are not considered as protected species. Indonesian law allows the hunting and trading of unprotected animals such as bats, but there is a legal permit (Law Number 5, year 1990; Government Act Number 8, year 1999) that is seldom enforced at a local level. Consequently, uncontrolled hunting poses a threat to the sustainability of bats in the wild (Lee et al. 2005).

Bat species traded

Based on body weight, morphological description, and morphometrics, the identified bats in the 12 traditional markets of South Minahasa, North Sulawesi, belong to seven species of fruit bats (family Pteropoodidae), as shown in Figure 3 and Table 1. Among these species, *P. alecto* and *A. celebensis*, are present in all markets, while *R. amplexicaudatus, T. nigrescens, N. cephalotes, C. minutus,* and *D. exoleta*, are found only in Pakuure, Tenga, Tompaso Baru, and Modoinding Markets.

Acerodon celebensis

The body weight of *A. celebensis* sold in traditional markets of South Minahasa similar with previous studies by Ransaleleh et al. (2013) in Manado City, but higher than body weight of traded *A. celebensis* in Dumoga market (Ransaleleh et al. 2020). The higher weight range observed in this research is attributed to the unrestricted massive hunting of bats before 2019, as there were no COVID-19 cases, preventing bats from reaching adulthood in their habitat and influencing the lower body weight of the catch. From 2019 to 2022, due to the COVID-19 pandemic, there was strict supervision at border checkpoints between North Sulawesi and Gorontalo Provinces as the trade points for wild animals, including bats.

Figure 3. Bat species found in traditional markets of South Minahasa District, North Sulawesi, Indonesia. A. *P. Alecto* and *A. celebensis*, B. Grilled flying fox, C. *D. exolete* (ventral view), D. *D. exolete* (dorsal view), E. *C. minutus*, F. *C. minutus* (ventral view), G. *N. cephalotes* (dorsal view), H. *N. cephalotes* (ventral view), I. *R. amplexicaudatus* (ventral view), J. *R. amplexicaudatus* (dorsal view), K. *T. nigrescens* (ventral view), L. *T. nigrescens* (dorsal view)

Table 1. Morphological measurements of the traded bats in traditional markets of South Minahasa District, North Sulawesi, Indonesia

Species	Morphological measurements of traded bats	
	This research	Other research
A.celebensis	Body weight ranging from 270-405g, with an average of 358.24±35.37g	Body weight ranging from 290.21-312.47g (Ransaleleh et al. 2020); ranging from 345.1±64.90g to 410.25±32.47g (Ransaleleh et al. 2013)
P. alecto	Body weight ranges from 150-700 g, with an average of 393.79±144.46 g.	Average body weight 508.89±97.88 g (Ransaleleh et al. 2013)
R.amplexicaudatus	Body weight ranges from 76.2±12.36 g to 89.4±9.85 g 67.1±15.71 g and 79.2±5.24 g, forearm length 75.2±1.99 mm-78.1±2.90 mm and 74.3±5.33 mm-75.4±1.57 mm, body length 71.7±2.31 mm-80.3±5.71 mm and 72.8±3.82 mm-74.9±3.41 mm, a head 35.1±2.77 mm-38.7±1.94 mm and 30.9±1.74 mm-35.0±1.15 mm, a thigh 32.7±1.33 mm-35.2±2.52 mm and 29.1±3.76 mm-35.2±2.52 mm, leg length 18.6±1.09 mm-20.1±1.47 mm and 18.3±1.19 mm-18.9±1.87 mm, ear length 17.4±1.17 mm-18.8±1.61 mm and 17.1±0.55 mm-18.1±0.75 mm, tail length 18.9±1.19 mm-20.6±2.33 mm and 15.5±1.27 mm-19.1±0.99 mm in males and females, respectively.	Body weight 72.75-75.63g, forearm length 71.66-72.75 mm, tail length 18.94 mm, an ear length 15.86-16.16 mm, leg length 17.66-18.38 mm (Ransaleleh et al. 2020) Forearm length 87.63±9.69 mm, a thigh length 45.56±56.77 mm, leg length 30.25±5.34 mm, ear length 27.75±2.56 mm (Ransaleleh et al. 2013)
T. nigrescens	Body weight of 64±14.34 g-79.1±1.85 g and 61.20±18.64 g-78.1±3.49 g, forearm length 72.5±2.07 mm-75.1±2.13 mm and 71.8±3.19 mm-74.4±1.51 mm, body length 73.6±4.38 mm-77.1±2.55 mm and 72.9±3.60 mm-76.2±3.52 mm, head length 31.8±2.29 mm-35.1±1.79 mm and 32.1±1.80 mm-34.2±1.69 mm, thigh length 29.6±0.87 mm-30.9±1.19 mm and 27.7±0.70 mm-30.3±1.42 mm, leg length 17.8±1.62 mm-23.1±0.86 mm and 17.7±1.70 mm-18.5±0.57 mm ear length 16.1±0.99 mm-17.6±0.96 mm and 15.8±1.23 mm-16.9±0.88 mm in males and females, respectively.	Body weight 83.65±34.61 g, forearm length 75.92±5.39 mm, thigh length 25.31 mm, leg length 25.31±3.84 mm, ear length 17.00±0.58 mm (Ransaleleh et al. 2013) Body weight 81.32 g - 93.69 g (Ransaleleh et al. 2020).
C. minutus	The body 36.4±5.29-56.5±4.11 g and 36.3±7.24-54.5±4.97 g, forearm length 56.1±2.37 mm - 58.6±1.95 mm and 54.2±2.20 mm - 55.9±2.12 mm, body length 57.1±1.85 mm - 57.9±2.42 mm and 55.3±2.98 mm - 57.3±1.05 mm, head length 23.6±1.07 mm - 25.9±1.10 mm and 23.3±1.70 mm - 25.1±0.71 mm, thigh length 22.2±1.40 mm - 23.4±0.97 mm and 21.7±0.95 mm - 22.3±1.64 mm, leg length 14.2±1.47 mm - 15.2±0.63 mm and 14.1±1.66 mm - 14.6±0.69 mm, ear length 13.7±0.67 mm - 15.1±0.73 mm and 13.3±1.57 mm - 14.3±0.67 mm, tail length 11.1±0.87 mm - 12.6±0.51 mm and 10.9±0.88 mm - 13.3±1.06 mm in males and females, respectively	Body weight 45 to 50 g, forearm 55 mm, body length 80-85 mm, head length 26.5-28 mm, leg length 10-12 mm (Ransaleleh et al. 2020) Forearm length 56.8-62.3 mm and 57.1-68.6 mm, a total body length 79.0-95 mm and 74.0-91.0 mm, thigh length 20.8-25 mm and 21.2-23.6 mm, leg length 8.8-14.5 mm and 9.7-13.9 mm, ear length 10.4-16.0 mm and 9.8-16.4 mm, tail length 5.9-10.6 mm and 3.6-12.8 mm for males and females, respectively (Donnelly et al. 2021)
N. cephalotes	Body weight 56.3±8.17-72.4±2.51 g and 52.70±10.13–71.9±3.72 g, forearm length 63.8±2.25 mm-68.8±2.51 mm and 65.1±2.57 mm-67.8±1.83 mm, body length 71.7±2.91 mm-75.1±1.64 mm and 68.1±4.01 mm-72.3±2.19 mm, head length 24.1±0.73 mm-25.4±1.14 mm and 24.6±0.74 mm-25.1±0.64 mm, a thigh length 24.4±0.44 mm-25.6±1.40 mm and 23.1±0.92 mm-24.5±1.35 mm, leg length 15.3±0.82 mm-16.2±0.83 mm and 15.1±0.88 mm-16.1±0.64 mm, ear length 17.7±1.64 mm-19.1±1.68 mm and 17.6±1.30 mm-17.6±1.56 mm, tail length 16.9±1.37 mm-18.2±0.70 mm and 16.6±1.43 mm-17.5±0.75 mm in males and females, respectively.	Body weight 52.60±4.55 g, forearm length 69.30±1.64 mm, thigh length 27.00±1.25 mm, leg length 19.60±0.84 mm, ear length 16.80±0.79 mm (Ransaleleh et al. 2013) Body weight 57.71g - 58.75g, forearm length 65.55-66.5 mm, total body length 114.66-118.25 mm, leg length 14.11-14.5 mm, ear length 14.22-14.5 mm, tail length 20.66-21.5 mm. (Ransaleleh et al. 2020).
D. exoleta	Body weight from 227.5±31.8g to 235.8±25.37g and 222.3±22.50g to 225.0±35.4g, forearm length 119.2±2.54 mm 119.5±2.12 mm and 117.3±1.52 mm - 119.0±1.41 mm, body length 127.0±2.45 mm - 127.5±1.54 mm and 125.7±2.52 mm - 127.5±3.53 mm, head length 47.8±1.67 mm - 51.5±2.12 mm and 52.3±1.73 mm - 52.5±3.53 mm, thigh length 53.0±1.92 mm - 53.5±2.12 mm and 51.3±1.53 mm - 53.0±2.12 mm, leg length 36.5±2.12 mm - 36.6±1.14 mm and 53.3±1.15 mm - 53.5±0.71 mm, an ear length of 26.5±0.71 mm - 26.8±1.14 mm and 26.3±0.57 mm - 26.5±0.71 mm, tail length of 20.4±0.55 mm - 21.5±0.71 mm and 20.3±0.58 mm - 20.5±0.71 mm in males and females, respectively	Body weight 244-248g for males and 162-177g for females (Flannery 1995) Body weight 282.21-320g, forearm length of 110-116.7 mm, a total body length of 171-220 mm, a leg length of 33.00-33.33 mm, and an ear length of 25.00-26.66 mm (Ransaleleh et al. 2020). Forearm length of 115.00-119.2 mm and 119.4 mm, total body length 157-181 mm and 165 mm, thigh length 51.8-58.1 mm and 52.10 mm, leg length of 21.5-30.2 mm and 15.1 mm, ear length 17.0-28.0 mm and 17.0 mm, tail length of 21.0-27.0 mm and 27 mm (Donnelly et al. 2021)

This phenomenon prevented hunters from capturing, as collectors had difficulty carrying and distributing to sellers in the markets. Consequently, bats in their natural habitat were able to grow and mature, thereby potentially influencing the body weight of the catch. The morphological characteristics of *A. celebensis* include hair covering the entire body, golden-yellow skin on wing fingers and ears, brownish wings, legs, wing fingers, and mouth, round eyes, no tail, and claws on the second wing finger, as also reported by Ransaleleh et al. (2020).

Pteropus alecto

Pteropus alecto weighing between 150-300 g are considered juveniles due to the underdevelopment of the genitals in males and the nipples in females. Moreover, *P. alecto* with body weight above 300 to 700 g are considered adults and have likely given birth, with some possibly nursing, as the nipples in lactating females are larger than non-lactating and younger ones. For 10 years, there has been a decrease in the average body weight by 115.1 g due to a larger proportion of sampled bats being juveniles. During the pandemic, bat hunters significantly reduced their activities, allowing *P. alecto* to thrive in their natural habitat. The increased availability in the market is due to young bats, specifically those nursing, getting caught alongside their mothers. This occurs when mothers are foraging at night with their young and are captured together by hunters. However, the young caught with their mothers are not released back into their habitat. The morphological characters of *P. alecto* include black fur covering the entire body, with some bats having reddish-orange coloration on the back of the neck, brownish-black legs and wings, no claws on the second finger, and no tail, as also reported by Ransaleleh et al. (2013).

Rousettus amplexicaudatus

The body weight of *R. amplexicaudatus* in Pakuure, Tenga, Pinaesaan Tompaso Baru, and Pinasungkulan Modoinding Markets ranges differs from that in Dumoga Market (Ransaleleh et al. 2020) due to varying conditions and available food in each bat's habitat, including the massive capture activities of all ages before the COVID-19 pandemic.

Observations across all markets in South Minahasa show that *R. amplexicaudatus* is the most commonly found species compared to others. The morphological characters in this research are in accordance with Dumoga Market, Bolaang Mongondow District, including greyish-brown fur, a tail, claws on the second wing finger, and a long snout (Ransaleleh et al. 2013; Ransaleleh et al. 2020). Another essential includes some males having orange coloration on their necks. In this research, the morphometrics of *R. amplexicaudatus* show still fall within the range obtained in previous research. (Flannery 1995; Ransaleleh et al. 2013; Ransaleleh et al. 2020).

Thoopterus nigrescens

Body weight of *T. nigrescens* in all the traditional markets of South Minahasa is lower compared to traded *T. nigrescens* in other traditional markets (Ransaleleh et al. 2013; Ransaleleh et al. 2020). Although the cause of the decrease in the body weight of *T. nigrescens* is not clear, observations show that this species is not consistently found in the traditional markets of South Minahasa during sample collection, or found in lower quantities compared to *R. amplexicaudatus*. Morphological characters of *T. nigrescens* include gray-brown fur, the absence of a tail, claws on the second wing finger, and a slightly round head with a short snout compared to *R. amplexicaudatus,* as reported by Ransaleleh et al. (2020). This research shows that morphological measurements of *T. nigrescens* fall within the range reported in previous research (Flannery 1995; Ransaleleh et al. 2013).

Cynopterus minutus

Cynopterus minutus is the smallest among bat species found in the traditional markets of South Minahasa, including Pakuure Village directly from hunters, as well as Pinaesaan Tompaso Baru and Pinasungkulan Modoinding Markets. In this research, showed significantly different values of body weight compared to the 2019 report on Dumoga Market. This variation suggests that the maturity level of *C. minutus* in the wild varies considerably due to habitat and food availability. Ransaleleh et al. (2013) reported that the habitat and food availability in the native area of bats can lead to differences in body weight. Based on interviews with hunters and sellers in the four markets, *C. minutus* caught are obtained from areas of community plantations with fruits around the villages and caves within the forest in Bolaang Mongondow District. The other morphological measurements of *C. minutus* in this research falls within the range reported in previous results (Ransaleleh et al. 2020; Donnelly et al. 2021).

Nyctimene cephalotes

In this research, *N. cephalotes* consisted of 48 bats, which were discovered in Pakuure, Pinaesaan Tompaso Baru, and Pinasungkulan Modoinding Markets. The greater variability in body weight occurred due to the COVID-19 pandemic where hunters rarely catch bats, food availability, and habitat in the wild, as *N. cephalotes* is caught by hunters along with other species at the same time and place. The morphological descriptions of *N. cephalotes* are consistent with those reported by Ransaleleh et al. (2020), such as a tube-shaped nose, yellowish-green skin color, brownish fur color, wings, wing fingers, and ears with yellow spots, a brown line along the back, the presence of a tail, and claws on the second wing finger. The other morphological measurements of *N. cephalotes* fall within the range reported by previous research (Flannery 1995; Ransaleleh et al. 2013; Ransaleleh et al. 2019).

Dobsonia exoleta

In data collection, *D. exoleta* was only found at Pinaesaan Tompaso Baru Market and from hunters in Pakuure Village, each with 4 bats. The body weight of males and females was not significantly different from Flannery (1995). However, the body weight in this research is lower compared to the values observed in Dumoga Market (Ransaleleh et al. 2020). The morphological characters of *D. exoleta* included a greenish-yellow color on the belly

fur, a furless back to the base of the tail showing the wings and a black-colored fused back, ivory-colored claws, no claws on the second finger, and a tail. These characteristics are consistent with those reported by Ransaleleh et al. (2020). The other morphological measurements of *D. exoleta* in this research falls within the range reported by previous research (Donnelly et al. 2021).

Traded bat handling and distribution

The traded bat handling process for *P. alecto* and *A. celebensis* begins from catchers and collectors to retail sellers in the markets. Initially, bats caught by hunters are stored frozen and retrieved by collectors every one or two weeks, depending on the quantity of accumulated bats. The journey from the hunting site to Manado typically takes approximately two days and after arrival in Minahasa and Manado, collectors distribute bats to sellers. Subsequently, the bats distributed by collectors are stored by sellers for some time and sold based on the market schedule. In the traditional markets, frozen bats are thawed, grilled using a blower, and presented in stalls or tables. Small fruit bats are sold ungrilled or grilled, serving as skewers, and are also prepared as coconut curry and *rica-rica* dishes, which are served with rice.

Conservation status of traded bats

Fruit bat species in Indonesia, including *P. alecto, A. celebensis, D. exoleta, N. cephalotes, C. minutus, R. amplexicaudatus,* and *T. nigrescens*, are currently lacking protection. According to the Minister of Environment and Forestry Regulation Number P.106/MENLHK/SETJEN KUM.1/6/2018 regarding Protected Plant and Animal Species, the protected bat species in Indonesia include *Acerodon humilis* and *Pteropus pumilus*, which is endemic to the Talaud Islands, as well as *Neopteryx frosti*, endemic to Sulawesi. The absence of legal status of unprotected bats is a contributing factor to their continued hunting and trading for consumption, posing a significant risk of extinction.

Based on the International Union Conservation of Nature (IUCN) Red List, the conservation status of *P. alecto, D. exoleta, N. cephalotes, C. minutus, R. amplexicaudatus,* and *T. nigrescens* is Least Concern (Roberts et al. 2017; Hutson et al. 2019; Tsang 2016; Ruedas and Suyanto 2019; Waldien et al. 2019; Wiantoro et al. 2020), while *A. celebensis* is classified as Vulnerable (Sheherazade et al. 2022). Maryanto et al. (2019) reported the distribution of these bats in Indonesia, *P. alecto* in the Lesser Sunda Islands, Sulawesi, Maluku, and Papua, *A. celebensis* and *D. exoleta* in Sulawesi, *C. minutus* in Kalimantan, Sumatra, Java, and Sulawesi, *N. cephalotes* in the Lesser Sunda Islands, Sumatra, Java, and Sulawesi, as well as *T. nigrescens* in Sulawesi and Maluku.

The Vulnerable status of *A. celebensis*, an endemic species in Sulawesi, raises significant concerns. Although the conservation status of other bats sold in the traditional markets of South Minahasa is the Least Concern, their sustainability in nature as seed dispersers and fruit pollinators requires proper monitoring. Currently, there is no report on the population and function of bats as seed dispersers, specifically in Sulawesi, but their function as pollinators for durian fruit trees has been investigated (Sheherazade et al. 2019). The sustainability of bats in Indonesia has not received much attention, as their direct benefits in nature are not well understood. Moreover, bat trade causes decreasing bat population such as Sulawesian endemic species, *A. celebensis* indicated by rare records of this species in North Sulawesi and probably migrate further to new place which has no human disturbance. To address this gap, comprehensive solutions are required to preserve their natural habitat, such as cultivation initiatives (Ransaleleh et al. 2021; Ransaleleh et al. 2022). Additionally, effective collaboration between academics and policymakers, particularly the relevant government authorities, is necessary to discuss the sustainability of bats in nature. Public awareness campaigns targeting communities, organizations, and schoolchildren are also crucial, including regulated capture rules and quotas. Adopting humanistic methods to hunters, collectors, and sellers while providing non-threatening and non-fearful explanations can lead to better understanding and provide positive results.

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REFERENCES

Akem ES, Pemunta NV. 2020. The bat meat chain and perceptions of the risk of contracting Ebola in the Mount Cameroon region. BMC Public Health 20: 593. DOI: 10.1186/s12889-020-08460-8.

Baqi A, Lim V-C, Yazid H, Khan FAA, Lian CJ, Nelson BR, Seelan JSS, Appalasamy S, Mokhtar SI, Kumaran JV. 2021. A review of durian plant bat pollinator interaction. J Plant Interact 17 (1): 105-126. DOI: 10.1080/17429145.2021.2015466.

Benerjee A, Misra V, Schountz T, Baker ML. 2018. Tools to study pathogen host interactions in bats. Virus Res 15: 5-12. DOI: 10.1016/j.virusres.2018.02.013.

Bumrungsri S, Bumrungsri W, Racey PA. 2006. Reproduction in the short-nosed fruit bat in relation to environmental factors. J Zool 272 (1): 73-81.DOI: 10.1111/j.1469-7998.2006.00245.x.

Donnelly M, Martin TE, Cropper O, Yusti E, Arfian A, Smethurst R, Fox C, Pryde M, Hafirun, Phangurha J, Van der Aar RN, Hutchison A, Karya A, Analuddin K, Samsudin, Jones SKC. 2021. New species records from Buton Island, South East Sulawesi, including regional range extensions. Bat Res Conserv 14 (1): 14-32. DOI: 10.14709/BarbJ.14.1.2021.03.

Flannery T. 1995. Mammals of the South-West Pacific & Moluccoan Islands. Sydney, Australian Museum/Reed Book.

Friant S, Paige SB, Goldberg TL. 2015. Drivers of bushmeat hunting and perceptions of zoonoses in Nigerian hunting communities. PLOS Neglect Trop Dis 9 (5): e0003792. DOI: 10.1371/journal.pntd.0003792.

Frick WF, Kingstone T, Flanders J. 2020. A review of the threat and challengers to global bat conservation. Ann N Y Acad Sci 1469 (1): 5-25. DOI: 10.1111/nyas.14045.

Galindo-González J. 2023. Avoiding novel, unwanted interactions among species to decrease risk of zoonoses. Conserv Biol 2023: e14232. DOI: 10.1111/cobi.14232.

Gupta P, Singh MP, Goyal K, Tripti P, Ansari MI, Obli Rajendran V, Dhama K, Malik YS. 2021. Bats and viruses: A death-defying friendship. Virus Dis 32: 467-479. DOI: 10.1007/s13337-021-00716-0.

Hutson AM, Helgen K, Kingston T, Sinaga U. 2019. *Dobsonia exoleta*. The IUCN Red List of Threatened Species 2019: e.T6775A22034230.

Koch LK, Cuize S, Kochmann J, Klimpel S. 2020. Bats as putative *Zaire ebolavirus* reservoir hosts and their habitat suitability in Africa. Sci Rep 10: 14268. DOI: 10.1038/s41598-020-71226-0.

Kingston T. 2010. Research priorities for bat conservation in Southeast Asia: A consensus approach. Biodivers Conserv 19: 471-484. DOI: 10.1007/s10531-008-9458-5.

Latinne A, Saputro S, Kalengkongan J, Kowel CL, Gaghiwuc L, Ransaleleh TA, Nangoy MJ, Wahyuni I, Kusumaningrum T, Safari D, Feferholtz Y, Li H, Hagan E, Miller M, Francisco L, Daszak P, Olival KJ, Pamungkas J. 2020. Characterizing and quantifying the wildlife trade network in Sulawesi, Indonesia. Glob Ecol Conserv 21: e00887. DOI: 10.1016/j.gecco.2019.e00887.

Lee RJ, Corog AJ, Dwiyahreni A, Siwu S, Riley J, Alexander H, Paoli GD, Romono W. 2005. Wildlife trade and implication for law enforcement in Indonesia: A case study from North Sulawesi. Biol Conserv 123 (4): 477-488. DOI: 10.1016/j.biocon.2005.01.009.

Maryanto I, Maharadatunkamsi, Achmad S, Wiantoro S, Sulistyadi E, Yoneda M, Suyanto A, Sugardjito J. 2019. Check list of mammals of Indonesia. Puslit Biologi Bogor, Bogor. [Indonesia]

Mickleburgh S, Waylen K, Racey P. 2009. Bat as bushmeat: A global review. Oryx 42 (2): 217-234. DOI: 10.1017/S0030605308000938.

Mildenstein T, Tanshi I, Racey PA. 2016. Exploitation of bats for bushmeat and medicine. In: Voigt CC, Kingstone T (eds). The Anthropocene Conservation of Bats in a Change World. Springer Nature, Switzerland. DOI 10.1007/978-3-319-25220-9.

Periasamy P, Hutchinson PE, Chen J, Bonne I, Hamees SSS, Selvam P, Hey YY, Fink K, Irving AT, Detertre CA, Baker M, Grameri G, Wang LF, Alonso S. 2019. Studies on B cell in the fruit-eating black flying fox (*Pteropus alecto*). Front Imunol 10: 489. DOI: 10.3389/Fimmu.2019.00489.

Ransaleleh TA, Maheswari RRA, Sugita P, Manalu W. 2013. Identification of Sulawesi fruit-eating bats based on morphometry. J Veteriner 14 (4): 485-494. [Indonesian]

Ransaleleh TA, Nangoy MJ, Wahyuni I, Lomboan A, Koneri R, Saputro S, Pamungkas J, Latinne A. 2020. Identification of bats on traditional market in Dumoga district, North Sulawesi. IOP Conf Ser: Earth Environ Sci 473: 012067. DOI: 10.1088/1755-1315/473/1/012067.

Ransaleleh TA, Wahyuni I, Kawatu M, Nangoy MJ, Wiantoro S. 2021. Behavior of the back flying fox, *Pteropus alecto* (Chiroptera: Pteropodidae) in cages. Biodiversitas 22 (12): 5636-5644. DOI: 10.13057/biodiv/d221262.

Ransaleleh TA, Wahyuni I, Kawatu M, Nangoy MJ, Laatung S, Lambey L, Rembet UNWJ. 2022. Growh of *Pteropus alecto* (Chiroptera: Pteropodidae) in cages. Biodiversitas 23 (12): 6313-6319. DOI: 10.13057/biodiv/d231227.

Roberts B, Eby P, Tsang Sm, Sheherazade. 2017. *Pteropus alecto*. The IUCN Red List of Threatened Species 2017: e.t18715a22080057.

Rocha R, Aziz SA, Brook CE, Carvalho WD, Cooper-Bohannon R. 2020. Bat conservation and zoonotic disease risk: A research agenda to prevent misguided persecution in the aftermath of COVID-19. Anim Conserv 24 (3): 303-307. DOI: 10.1111/acv.12636.

Ruedas L, Suyanto A. 2019. *Cynopterus minutus*. The IUCN Red List of Threatened Species 2019: e.t136423a21985433.

Shah MNM, Johan KBM, Roslan A, Basri HZH, Pesiu E, Zahadin MA, Abdullah MT, Zalipah MN. 2021. Seed and pollen dispersal by small pteropodid bats in lowland forest of Terengganu Peninsula Malaysia. J Wildl Parks 36: 75-93.

Sheherazade, Tsang SM. 2018. Roost of gray flying foxes (*Pteropus griseus*) in Indonesia and records of a new hunting threat. Diversity 10 (3): 102. DOI: 10.3390/d10030102.

Sheherazade, Ober HK, Tsang SM. 2019. Contribution of bats to the local economy through durian pollination in Sulawesi, Indonesia. Biotropica 51 (6): 913-922. DOI: 10.1111/btp.12712.

Sheherazade, Tsang SM, Matorang Z. 2022. *Acerodon celebensis*. The IUCN red list of threatened species 2022: e.T137A220501878.

Suwannorang K, Schuler S. 2016. Bat consumption in Thailand. Infect Ecol Epidemiol 6 (1): 29941. DOI: 10.3402/iee.v6.29941.

Tremlett CJ, Moore M, Chapman MA, Zamora-Gutierrez V, Peh KS. 2020. Pollinators by bats enhance both the quality and yield of a major cash crop in Mexico. J Appl Ecol 57: 450-459. DOI: 10.1111/1365-2664.13545.

Tsang SM. 2016. *Nyctimene cephalotes*. The IUCN Red List of Threatened Species 2016: e.T14963A22007414.

Waldien DL, Wilson Z, Adleson S, Abdul Aziz S, Bates PJJ, Bumrungsri S, Furey N, Ingle NR, Mildenstein T, Phelps K, Tanalgo K, Soisook P, Thong VD, Wiantoro S, Tsang SM. 2019. *Rousettus amplexicaudatus*. The IUCN Red List of Threatened Species 2019: e.T19754A22001514.

Wang L-F, Anderson DE. 2019. Viruses in bats and potential spillover to animals and humans. Curr Opin Virol 34: 79-89. DOI: 10.1016/j.coviro.2018.12.007.

Wang L, Ahn M, Anderson DE. 2021. Bats and coronavirus in the context of COVID-19. China CDC Wkly 3 (7): 153. DOI: 10.46234/ccdcw2021.045.

Wiantoro S, Hitch AT, Engilis IE, Gunawan H, Engilis A. 2016. Bats (Chiroptera) recorded in the lowland of Southeast Sulawesi, Indonesia with notes on taxonomic status and significant range extensions. Mammalia 81 (4): 385-400. DOI: 10.1515/mammalia-2015-0153.

Wiantoro S, Tsang SM, Ruedas LA, Kingston T, Helgen K, Sinaga J. 2020. *Thoopterus nigrescens*. The IUCN RedList of Threatened Species 2020: e.t21815a21989441. DOI: 10.2305/IUCN.UK.2020-2.RLTS.T21815A21989441.en

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