

The bushmeat trade in traditional markets in North Sulawesi, Indonesia

TILTJE ANDRETHA RANSALELEH^{1,*}, INDYAH WAHYUNI¹, MERRI DIANA ROTINSULU¹,
MEIS JACINTA NANGOY¹, AGUSTINUS LOMBOAN¹, JANE ONIBALA¹, SYLVIA LAATUNG¹,
LIDYA SIULCE KALANGI¹, SURYO SAPUTRO², SIGIT WIANTORO³

¹Faculty of Animal Science, Universitas Sam Ratulangi. Jl. Kampus Barat, Bahu, Malalayang, Manado 95115, North Sulawesi, Indonesia.

Tel./fax.: +62-43-863786, *email: taransaleleh@unsrat.ac.id

²Primate Research Center, Institut Pertanian Bogor. Jl. Lodaya II No.5, Babakan, Bogor 16151, West Java, Indonesia

³Museum Zoologium Bogoriense, Research Center for Biosystematics and Evolution, National Research and Innovation Agency (BRIN). Jl. Raya Bogor, Cibinong, Bogor 16911, West Java, Indonesia

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Abstract. Ransaleleh TA, Wahyuni I, Rotinsulu MD, Nangoy MJ, Lomboan A, Onibala J, Laatung S, Kalangi LS, Saputro S, Wiantoro S. 2025. The bushmeat trade in traditional markets in North Sulawesi, Indonesia. *Biodiversitas* 26: 1929-1939. The bushmeat trade, which involves harvesting wild animal meat, is causing significant changes in the ecological balance of flora and fauna, with potential implications for human health and well-being. Traditional markets in several districts and cities in North Sulawesi Province, Indonesia, serve as centers for the bushmeat trade. Therefore, this study aimed to inventory and map the locations of market centers for bushmeat trade, provide current data, and monitor the types of endemic wild animals that are protected but are used as food in North Sulawesi. Hence, 11 markets were surveyed, namely Dumoga, Imandi, Ibolian, Amurang, Motoling, Kawangkoan, Langowan, Beriman, Airmadidi, Bersehati, and Pinasungkulan. Direct observations were implemented in each market every month from April to September 2024. The obtained data were then identified, tabulated, analyzed, and described in a descriptive manner. The results showed that the types of traded bushmeat were wild boar, bats, white-tailed forest rats, rice field rats, Sulawesi bear cuscus, Small Sulawesi cuscus, weris birds, and rice field snakes. Two species of cuscus are endemic to Sulawesi and adjacent islands and are listed as threatened species under the IUCN Red List. Moreover, the small Sulawesi cuscus is protected under Indonesian regulations. The two species of bats identified were *Acerodon celebensis* and *Styloctenium wallacei*, both of which are endemic to Sulawesi and listed as threatened species under the IUCN. Our observation showed that bushmeat trade was found in all 11 traditional markets in North Sulawesi, providing endemic and non-endemic and, as well as protected species under government regulation. Further conservation interventions are needed, including law enforcement strategies, education, and public awareness about the role of wild animals in providing ecosystem services and maintaining ecological balance in the surrounding environment.

Keywords: Bushmeat trade, conservation, Sulawesi, wildlife

INTRODUCTION

Wild animals play a crucial role in maintaining the balance of the forest ecosystem, serving as seed dispersers, pollinators of fruit trees, and suppressors of insect pests and disease vectors. However, overexploitation in their natural habitats continues to impact forest diversity indirectly (Symes et al. 2018; Ramirez-Francel et al. 2021; Stewart et al. 2024). The trade and use of wild animal meat (bushmeat) as food are among the contributors to food security in several parts of the world (Ballari and Barrios-Garcia 2014; Challender et al. 2015; Suwannorang and Schuler 2016; Wilkie et al. 2016; Bonwitt et al. 2018; Benítez-López et al. 2019; Chausson et al. 2019; Batumike et al. 2021; Hariohay et al. 2023; Kadigi et al. 2023). A similar situation also occurs in Indonesia, particularly in North Sulawesi (Sheherazade and Tsang 2015; Latinne et al. 2020; Ransaleleh et al. 2020; Laatung et al. 2021). Wild animal is used as a source of meat by some communities, especially on special days or events such as personal and family birthdays, thanksgiving, wedding Thanksgiving, moving into a new home, celebrating Christmas, entering the New Year, Good Friday, and Easter, as well as giving

thanks for the blessings obtained from fruit harvesting and other traditional events (Ransaleleh et al. 2024).

Wild animal hunting and trading have negative consequences for wildlife populations and sustainability (Hema et al. 2019). Sulawesi, Indonesia, is one of the islands with high wildlife diversity, comprising endemic and non-endemic species. This island comprises six provinces: Southeast, South, West, Central, Gorontalo, and North Sulawesi. Among the provinces, North Sulawesi has the market share and serves as the center of the bushmeat trade. The types of bushmeat consumed by some communities in North Sulawesi from the mammalian group include wild boar, rats, bats, weaver birds, cuscus, and pythons (Latinne et al. 2020; Ransaleleh et al. 2020, 2024). In addition to bushmeat from the mammal group, birds and reptiles are also used as food sources. Onibala and Laatung (2009) reported that the types of bushmeat that are hunted and traded for food in Sulawesi include black monkeys (11%), wild boar (17%), forest rats (38%), bats (22%), cuscus (6%), and birds (6%). The traded bushmeat was not only supplied from the North Sulawesi. Rats and several types of birds were hunted in North Sulawesi. At the same time, bushmeat sourced from wild boars, bats, and pythons

was supplied from five other provinces in Sulawesi, making North Sulawesi a centre of the bushmeat trade.

Bailey et al. (2021) reported that, from 2011 to 2018, the bushmeat trade declined in some markets in North Sulawesi; however, wild boar, bat, and rat meat are still traded in large quantities. Some traditional markets and supermarkets sell various types of wild animals (Latinne et al. 2020; Ransaleleh et al. 2024). The current problem is that as long as wild animals continue to be hunted, their biological resources, particularly those of endemic species, face a high risk of extinction. Consequently, Sulawesi and Indonesia were losing local resources that are unique to these regions and countries. Due to the loss of biological resources, biodiversity will be threatened, with the potential for ecological imbalance that could affect human welfare. Moreover, information on the current situation and scientific reports on the trading of wild animals are still lacking and incomplete in locations that are centers of the bushmeat trade. Therefore, this study aimed to map the locations of traditional markets that are the centers of bushmeat trade in North Sulawesi and to provide current data on the traded species, including endemic and non-endemic species, as well as their conservation status. The results were expected to provide policymakers, including local governments, protection area managers, national parks, and local communities, with valuable information to maintain and protect the sustainability of animal populations in nature.

MATERIALS AND METHODS

Study area

This study was conducted in bushmeat trade centers across five districts in North Sulawesi, Indonesia, including Minahasa District, with markets in Langowan and Kawangkoan, as well as Beriman Market in Tomohon City. Others included Airmadidi Market in North Minahasa District, Motoling and Amurang Markets in North Minahasa District, Ibolian Market, Dumoga and Imandi Markets in Bolaang Mongondow District, and Pinasungkulan Karombasan and Bersehati Markets in Manado City, as shown in Figure 1. Subsequently, monitoring was conducted over a six-month period, from April to September 2024.

Procedures and data analysis

The method employed in this study involved direct observation through visits to each traditional market, as well as conducting interviews with hunters, bushmeat sellers, and collectors. Data collection is performed monthly at each market according to its operating schedule (Ransaleleh et al. 2024). Initially, permission was sought from the village head and market foreman, followed by personal introductions to the sellers before data collection began. This process involved requesting permission to gather data through the inventory, identification, and documentation of all types of bushmeat sold at the visited markets. In addition, the homes of several sellers, who served as bushmeat collectors, were visited, and the data were recorded on a working paper.

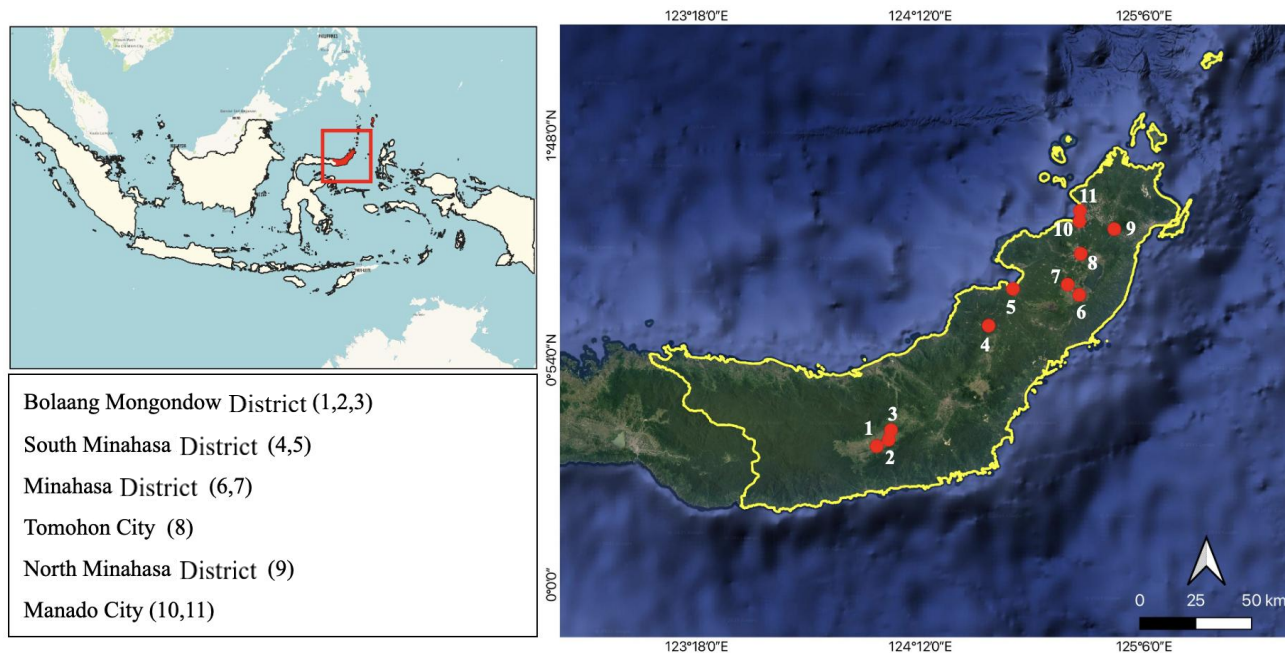


Figure 1. The bushmeat trade centre in North Sulawesi, Indonesia, encompasses 11 markets across five districts and sub-districts

The data on traded animals were evaluated for their conservation status based on the International Union for Conservation of Nature (IUCN Red List) and the Regulation of the Indonesian Minister of Environment and Forestry

Number P.106/MENLHK/SETJEN/KUM.1/12/2018 concerning protected plant and animal species. In addition, although bushmeat is being traded locally, we also consider verifying the traded species against the list of Appendix species in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). All collected data were tabulated, interpreted, and presented with images and descriptive narration. The data included an inventory of bushmeat types traded based on market location and characteristics of various animal types, along with the selling price of bushmeat per kilogram.

RESULTS AND DISCUSSION

Types of bushmeat trade in traditional markets in North Sulawesi, Indonesia

The types and locations of bushmeat trade in traditional markets in North Sulawesi are shown in Figure 2.

Dumoga, Imandi and Ibolian Markets, Bolaang Mongondow District, North Sulawesi, Indonesia

Bolaang Mongondow District is located in North Sulawesi Province. This district features several traditional markets that serve as centers for the sale of bushmeat. Dumoga Market, situated in East Dumoga Sub-district ($0^{\circ}37'9.30''\text{N}$, $124^{\circ}4'53.65''\text{E}$), operates on Tuesdays and Fridays. Imandi Market, also in East Dumoga Sub-district ($0^{\circ}34'50.04''\text{N}$, $124^{\circ}4'21.38''\text{E}$), is open every Monday, Wednesday, and Saturday, while Ibolian Market in West Dumoga Sub-district ($0^{\circ}33'17.07''\text{N}$, $124^{\circ}1'27.90''\text{E}$) runs every Tuesday, Thursday, and Sunday. The travel time by private vehicle from Manado City to the Dumoga, Imandi, and Ibolian Markets is approximately five to six hours.

According to discussions with a wild animal collector, there are several hunters and sellers in the Dumoga Sub-district. However, only four collectors, including bushmeat sellers, operate across various markets in the Dumoga, Imandi, and Ibolian areas, following a set schedule. One collector also sells bushmeat via Facebook and outside the Dumoga area, including markets in Tenga, Amurang, and Tumpaan in the South Minahasa Region. The bushmeat trade in the Bolaang Mongondow area is supplied by collectors who source wild animals from outside North Sulawesi Province, including wild boars, pythons, and bats (such as flying foxes). Meanwhile, white-tailed rats, field rats, small fruit bats, and birds generally come from around the Nani Warta Bone Forest in Bolaang Mongondow.

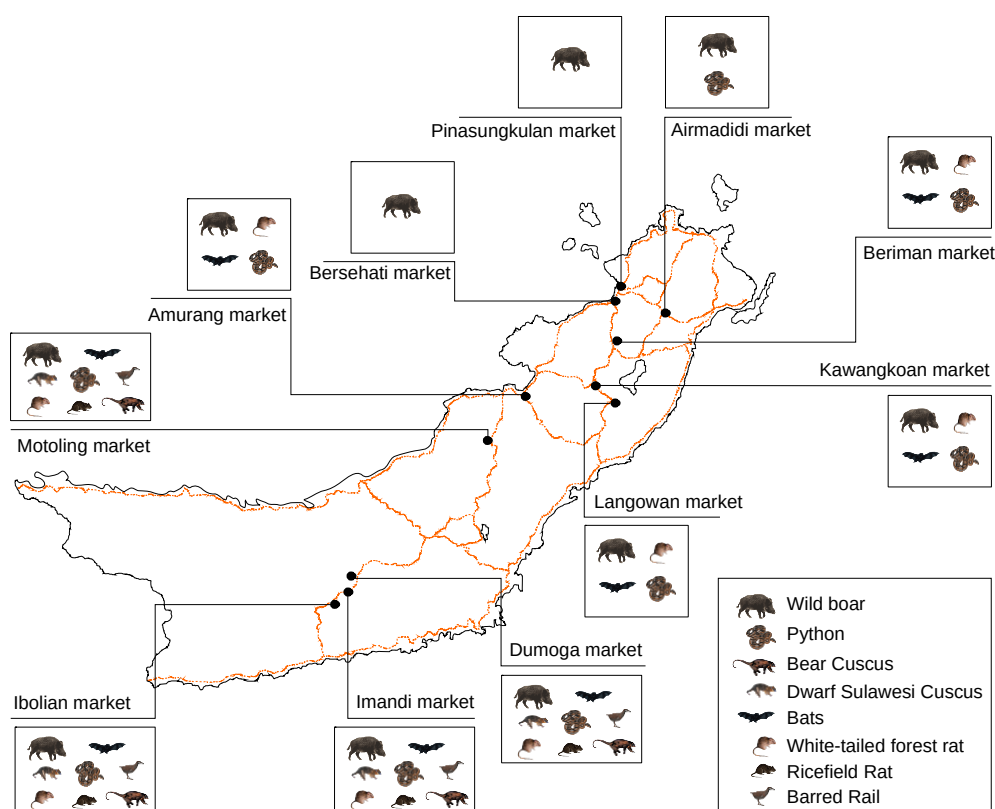


Figure 2. Types and locations of bushmeat trade in North Sulawesi, Indonesia

The results of monitoring bushmeat trade for six months, from April to September, in the Dumoga, Imandi, and Ibolian Markets showed significant variations. These included wild boar meat (*Sus scrofa*), various types of fruit bat meat (Chiroptera), and rats from the forest with whitetails, referred to by the community as "white-tailed rats" (Family Muridae), as well as field rats or those with black tails, commonly known as "lolak rats." Furthermore, there were mandar birds or weris birds (*Gallirallus* sp.), pythons, referred to as "patola," and in certain communities in Minahasa, known as "tumatongko" (*Malayopython* sp.). The Small Sulawesi cuscus (*Strigocuscus celebensis*), commonly referred to by the community as "tebung," was only available at the Dumoga Market in May. At the Imandi Market, the meat was available in May, July, and August, while at the Ibolian Market, it was available in April and August 2024. Latinne et al. (2020) reported that one type of bushmeat sold in the three markets of Dumoga, Imandi, and Ibolian included wild boar, forest rats, pythons, and bats. This indicates that the practice of hunting wild animals and the bushmeat trade in the three traditional markets is ongoing, suggesting a need for educating hunters and traders. Knowledge about the role of wild animals in nature and the negative impacts of continuous hunting must be communicated. This will foster a mindset that is more considerate of the surrounding natural environment.

Amurang and Motoling Markets, South Minahasa District, North Sulawesi, Indonesia

Amurang and Motoling are two types of traditional markets in South Minahasa, North Sulawesi. Specifically, Amurang Market is situated in Uwuran Satu Village, Amurang Sub-district (1°11'8.30"N, 124°34'20.79"E), and operates daily from morning until evening (Ransaleleh et al. 2024). It can be reached in one to one and a half hours from Manado by private vehicle. Motoling Market is located in Motoling Dua Village, Motoling Sub-district (1°2'16.67"N, 124°28'27.96"E) and is open only once a week, specifically on Thursdays from morning to evening. Monitoring the bushmeat trade over six months, from April to September, at Amurang Market revealed significant variation. Wild boar meat (*S. scrofa*), fruit bats of the *Pteropus alecto* as well as *Acerodon celebensis* species, and python meat were tracked in April, July, August, and September 2024. At Motoling Market, wild boar, white-tailed forest rats, bats of the *P. alecto* and *A. celebensis* species, and weris birds were observed from April to September 2024, alongside Small Sulawesi cuscus in April, June, July, August, and September 2024. Notably, one Sulawesi bear cuscus (*Ailurops ursinus*) was recorded in April 2024. This study found no evidence of monkey, anoa, or babirusa meat at Motoling Market, nor monkeys and rats at Amurang Market, as previously reported by Latinne et al. (2020).

Based on an interview with a seller at Amurang Market, the supplier who distributes wild boar and bats there also provides bushmeat at Motoling. Specifically, collectors acquire pythons from suppliers who hunt bushmeat in Central, South, and Southeast Sulawesi, including

Amurang. Hunters from around Amurang often supply live pythons, which are promoted via social media platforms like Facebook. Some bushmeat sellers at Amurang Market also utilize social media to sell without having to move between markets. Meanwhile, bushmeat traders at Motoling Market typically travel around selling meat from one market to another within the Motoling Sub-district.

Kawangkoan and Langowan New Markets, Minahasa District, North Sulawesi, Indonesia

Kawangkoan and Langowan New Markets are situated in Minahasa District. Specifically, Kawangkoan Market is located in Uner Village (1°12'9.12"N, 124°47'32.57"E), North Kawangkoan Sub-district, North Minahasa District. When traveling by private vehicle, the distance from Manado City to Kawangkoan Market ranges from 1 hour and 20 minutes to 1 hour and 30 minutes. This market is open every Thursday, Saturday, and Monday. Langowan New Market is located in Toraget Village (1°9'40.46"N, 124°50'19.10"E), North Langowan Sub-district, Minahasa District. It opens every Tuesday and Saturday and can be reached in approximately 2 to 2.5 hours from Manado by private vehicle.

Traders in the Langowan and Kawangkoan Markets differ significantly from those in the Dumoga, Imandi, Ibolian, and Motoling areas, who move around selling bushmeat based on market days at various locations. In contrast, traders at Langowan and Kawangkoan Markets remain in a single market. Monitoring results from April to September 2024 indicate that the Langowan and Kawangkoan Markets offer wild boars, white-tailed forest rats, various types of rice field rats, bats such as *P. alecto* and *A. celebensis*, as well as pythons. Information gathered reveals that bats, wild boars, and rice field snakes are sourced from areas outside North Sulawesi, while local hunters collect white-tailed rats from around Kawangkoan and Langowan. Typically, white-tailed rats are sold by women who are the wives of these hunters. Each bushmeat trader in Langowan and Kawangkoan sells wild boar and bat meat in roughly equal amounts. This study did not assess the quantity of bats and wild boars sold. According to the monitoring, bat and wild boar meat are the bushmeat items that attract the most interest from visitors. Latinne et al. (2020) reported that wild boar meat was the top seller, followed closely by bats and pythons in the Langowan and Kawangkoan Markets.

Beriman Tomohon Market, Tomohon City, North Sulawesi, Indonesia

The Beriman Tomohon Market, known as the extreme market, sells bushmeat in the Paselaten Satu Village of the East Tomohon Sub-district (1°19'34.39"N, 124°50'43.34"E), Tomohon City, North Sulawesi. This market operates daily but becomes particularly crowded on Saturdays with buyers of essentials as well as numerous local and international tourists who wish to observe the various types of animals for sale. Beriman Tomohon Market is located 25 km from Manado City and can be reached by vehicle in approximately forty minutes to an hour. It serves as one of the main sales centers for

bushmeat in Tomohon City, featuring around 15 dedicated stalls for extreme meat vendors. Monitoring conducted from April to September 2024 revealed that the most sold animal meats are wild boar and pythons, available in frozen and whole formats, with each vendor selling three to five of each. Bats and white-tailed rats are sold in smaller quantities, while each seller offers three to five wild boars on market days. Additionally, bat meat is typically limited to four to five individuals, with the overall sales of bats and rats not exceeding thirty. According to discussions with one seller, wild boar and bats are sourced from South and Central Sulawesi, while hunters in Tomohon supply white-tailed rats. Bats are becoming increasingly difficult to procure due to oversight from relevant authorities, particularly forest police monitoring captures in the South Sulawesi region. This situation contrasts sharply with sales in 2018-2019, when each stall sold bats in quantities ranging from 50 to 100. Research by Latinne et al. (2020) indicated that bats sold at the Tomohon Bersehati Market from November 2018 to January 2019 were the most prevalent, followed by wild boars and pythons.

Airmadidi Market, North Minahasa District, North Sulawesi, Indonesia

Airmadidi Traditional Market is situated in Soroinsong Village (1°25'30.47"N, 124°58'46.88"E), Airmadidi Sub-district, North Minahasa District, North Sulawesi Province. This market opens every Tuesday, Thursday, and Saturday of each week, serving as the largest traditional market in North Minahasa. It is strategically placed on the edge of the Manado-Bitung highway, near the intercity vehicle terminal, shopping center, and Airmadidi health center. The distance from Manado City to Airmadidi Market is 27 km, which can be traveled in approximately one and a half hours via public roads. However, if you take the toll road from Manado, it takes about forty-five minutes. This market offers bushmeat, but there is notable variation compared to Tomohon, Minahasa Induk (Kawangkoan and Langowan), South Minahasa (Amurang and Motoling), and Bolaang Mongondow (Dumoga, Imandi, and Ibolian). In this market, only two vendors sell bushmeat, primarily wild boar and a few pythons. According to discussions with bushmeat sellers, the wild boar, and pythons available here originate from Central, West, and Southeast Sulawesi Provinces. Python meat buyers have noted that white-tailed rats are not available in the market despite these transactions being conducted online.

Bersehati and Pinasungkulan Markets, Manado City, North Sulawesi, Indonesia

Pinasungkulan and Bersehati are the two largest markets in Manado City, North Sulawesi. In comparison, Pinasungkulan Market is situated in North Karombasan Village (1°27'21.75"N, 124°50'22.24"E), Wanea Sub-district, Manado City, while Bersehati Market is located in Calaca Village (1°29'52.43"N, 124°50'29.10"E), Wenang Sub-district, Manado City. Based on monitoring results over six months, from April to September 2024, these two markets exclusively sell wild boar meat. Compared to previous years, Pinasungkulan Karombasan Market still

has approximately one to two sellers of bats and pythons. Latinne et al. (2020) reported that during 2018-2019, both the Pinasungkulan Karombasan Market and several supermarkets offered wild boar meat, bats, and pythons. According to observations, bats and white-tailed rats are not available in these two traditional markets but can be found in several supermarkets in Manado City.

Characteristics of wild meat traded in traditional markets in North Sulawesi, Indonesia

Wild boar (Suidae)

The results revealed that wild boar, or *celeng* (*S. scrofa*), meat was frequently available in 11 traditional markets. These included the Dumoga, Imandi, and Ibolian Traditional Markets in Bolaang Mongondow District, Kawangkoan and Langowan in Minahasa District, Amurang and Motoling in South Minahasa, Beriman in Tomohon City, a traditional market in Airmadidi Sub-district, North Minahasa, and Pinasungkulan Market, as well as Bersehati Market in Manado City. Latinne et al. (2020) reported the findings of a survey conducted from 2018 to 2019, indicating that one type of bushmeat sold in North Sulawesi was wild boar meat. This suggests the community's interest in consuming wild boar meat, highlighting the presence of the trade in North Sulawesi since 2018, which remains consistently available. The types and characteristics of the wild boar meat trade, based on observations, include hunters' catches that have been gutted, cut into two parts or half carcasses, placed into styrofoam boxes, and transported by car to North Sulawesi via land. Furthermore, it is distributed to bushmeat traders and stored in freezers. On market days, this bushmeat is brought to the market in frozen form, thawed, and cut into pieces according to consumer demand (Figure 3). Based on observations in traditional markets, wild boar meat is initially burned or smoked to remove hair using a gas burner connected to Liquefied Petroleum Gas (LPG) before being handed over to consumers.

Although there is no information available on the daily consumption of wild boar meat in terms of the number of heads or kilograms, the continuous availability of this meat from 2018 to the present could pose a threat to the forest ecosystem. This is because one of the roles of wild boars is to maintain the ecological cycle within the forest. However, farmers consider this animal a pest due to its potential to damage crops and spread African Swine Fever (ASF) (Osses et al. 2022; Tarvydas and Belova 2022; Spoula et al. 2024). Based on interviews with sellers and collectors, the wild boar meat they trade comes from Central, South, and Southeast Sulawesi.

Bats (Pteropodidae)

The study identified eight bat species in North Sulawesi Province: *Pteropus alecto*, *A. celebensis*, *Dobsonia exoleta*, *Nyctimene cephalotes*, *Rousettus celebensis*, *R. amplexicaudatus*, *Styloctenium wallacei*, and *Thoopterus nigrescens*. Specifically, only two species were noted in the Amurang, Motoling, Kawangkoan, Langowan, and Tomohon Markets: *Pteropus alecto* and *A. celebensis*. No bat trade was documented in the Airmadidi, Bersehati, and

Pinasungkulan Markets, which is noteworthy, as traders at the Airmadidi market and the Pinasungkulan Karombasan Market have previously dealt in bats (Latinne et al. 2020). Since the onset of the COVID-19 pandemic, traders have infrequently sourced bats from suppliers and hunters due to substantial losses in 2020, as their bats went unsold. Some bats traded included fresh or unsmoked, smoked, and skewered varieties (Figure 4), predominantly found in the Dumoga, Imandi, and Ibolian Markets. Discussions with hunters and sellers in these markets revealed that some *P. alecto* and *A. celebensis* bats are caught not far from Bolaang Mongondow, as evidenced by their fresh state with warm, pliable bodies. However, the hunters were only detailed netting bats in coastal areas that featured mangrove forests without disclosing specific hunting locations. It's suspected that these hunters operate around the Nani Warta Bone Forest, towards the south coast of Bolaang Mongondow, and into Gorontalo. Latinne et al. (2020) indicated that one of the bat-hunting zones in Sulawesi is the mangrove forest. Ransaleleh et al. (2020) also documented seven bat species traded in the Dumoga, Imandi, and Ibolian Markets, including *A. celebensis* (Sulawesi flying fox), *D. exoleta* (Sulawesi naked-backed

fruit bat), *Neopteryx frosti* (Small-toothed fruit bat), *N. cephalotes* (Pallas's tube-nosed bat), *R. amplexicaudatus* (Geoffroy's rousette), *S. wallacei* (Sulawesi stripe-face fruit bat), and *T. nigrescens* (Swift fruit bat). The Motoling and Amurang Markets exclusively featured *P. alecto* and *A. celebensis* (Ransaleleh et al. 2024). All species reported in this study were also identified by Ransaleleh et al. (2020), with the exception of *N. frosti* and *P. alecto*.

Rats (Muridae)

White-tailed forest rats inhabit and forage in both primary and secondary forests, whereas rice field rats thrive around rice fields featuring rice plants and community plantations. In contrast, white-tailed forest rats have white tails and can weigh up to 300 g, while rice field rats possess black tails and average 100 g. The varieties of white-tailed forest and rice field rats observed in this study were diverse and available in frozen form, which was thawed and smoked. However, some were sold fresh, highlighting the necessity for an identification process to ascertain the species of rats present in markets, as illustrated in Figure 5.



Figure 3. Wild boar is traded in traditional markets in North Sulawesi, Indonesia



Figure 4. *Pteropus alecto* and *Acerodon celebensis* traded in North Sulawesi, Indonesia



Figure 5. White-tailed and black-tailed rats traded in North Sulawesi, Indonesia

A special study is needed to identify the types of white-tailed forest and rice field rats that will be hunted for consumption in the future. Although the species of white-tailed forest rats is not specifically known, their toes and tails are white for almost three-quarters, half, and one-third of the length of their tails. Some are also white only at the tip or along their tails. Similarly, rice field rats have a white belly and a grayish hue on their backs, but their tails are grayish-black and quite short, with smaller bodies compared to white-tailed forest rats. Latanne et al. (2020) reported that in North Sulawesi, seven endemic white-tailed and three black-tailed rats were consumed. Furthermore, Laatung et al. (2021) reported eight species of white-tailed forest rats in Minahasa and Bolaang Mongondow. There were differences in the number and species of rats consumed in North Sulawesi, as well as the community's ability to obtain them.

Cuscus (Phalangeridae)

The cuscus found in traditional markets includes the Small Sulawesi cuscus and bear cuscus. The Small Sulawesi cuscus, also known as the Sulawesi dwarf cuscus (*S. celebensis*), is exclusively available in the Imandi and Ibolian Markets of Bolaang Mongondow District, as well as in the Motoling Market of South Minahasa District, North Sulawesi. However, the Small Sulawesi cuscus isn't guaranteed to be found in traditional markets each month. This species is referred to as "tebung" by sellers and is often classified as a rat, despite significant differences, since the Small Sulawesi cuscus is a marsupial mammal.

The characteristics of the Small Sulawesi cuscus include its woolly, thick hair covering the entire body. The tip of the tail is hairless, and its body is larger than that of the white-tailed forest rat. The hair color ranges from dark brown on the head and back to light brown on the chest and stomach. In females, a small pouch is located in the stomach for storing their young. Based on study results, the

number of tembung sold varied, with more than 30 being sold at a time on market days, compared to the white-tailed and field rats. Small Sulawesi cuscus was found in numbers ranging from one to four and was not consistently observed each month during the study. The Sulawesi bear cuscus (Family Phalangeridae), namely *A. ursinus*, was also recorded (Figure 6). Latanne et al. (2020) reported that cuscus is among the animals traded in traditional markets in North Sulawesi, indicating that the trade in Small Sulawesi cuscus in North Sulawesi has continued from year to year.

Weris bird (Rallidae)

The weris bird is the local name for the Rallidae family, class Aves, genus *Gallirallus*, found in North Sulawesi. In Indonesia, it is commonly referred to as the mandar bird. There are two types of weris birds in Sulawesi: *Gallirallus torquatus*, also known as Barred Rail, and *G. philippensis* or Buff-banded Rail. The distinguishing characteristics of these two species are indicated by the white line that runs under and above the eyes, extending to the back of the skull (Figure 7). Lambey et al. (2022) reported that in North Sulawesi, specifically in Minahasa, there are two species of weris birds: *G. torquatus*, which features a white line beneath the eyes, and *G. philippensis*, which has a white line above the eyes. In this study, both types of weris birds were observed and were only found in the Dumoga, Imandi, and Ibolian markets in Bolaang Mongondow District.

Pythons (Pythonidae)

Pythons, also known as sanca snakes, are referred to as "tumotongko" by some communities in Minahasa. Generally, pythons belong to the Pythonidae family, class of Reptilia, and are traded in 11 markets that serve as the focus of this study in North Sulawesi Province. The

specific species of pythons traded remain unidentified, as expert identification is required. Dickson et al. (2017) noted that five species of pythons were reported: *Malayopython reticulatus*, *Python bivittatus*, *P. curtus*, *P. brongersmai*, and *P. breitensteini*, which are extensively exploited for industrial purposes, food, and traditional medicine. Septiadi et al. (2019) indicated that *M. reticulatus reticulatus* is the largest and longest among pythons and is heavily utilized in the luxury leather industry. They are distributed across Southeast Asia and throughout most of the Indonesian archipelago. According to Auliya et al. (2002), the reticulated python comprises three subspecies: *Python reticulatus reticulatus*, *P. r. jampeanus* from Tanahjampea Island, South Sulawesi, and

P. r. saputrai from Salayar Island, South Sulawesi. *Python r. reticulatus* displays a yellowish-brown skin pattern that is not contrasting, as the color is faint across the body. In contrast, *P. r. jampeanus* shows a skin pattern devoid of yellow, predominantly dominated by grey. *Python r. saputrai* has a striking skin pattern characterized by a golden-yellow hue. Based on these skin patterns, all three subspecies of reticulated pythons are sold in the traditional markets of North Sulawesi (Figure 8). Discussions with traders in these markets reveal that, apart from being sourced from collectors in Central and South Sulawesi, batik pythons are often captured by hunters around North Sulawesi and transported to collectors alive, measuring between 5 to 8 meters in length.



Figure 6. Two species of cuscus, which were traded in traditional markets in North Sulawesi, Indonesia



Figure 7. Species of weris birds traded in the Dumoga, Imandi, and Ibolian markets, Bolaang Mongondow District, North Sulawesi, Indonesia



Figure 8. Batik pythons traded in North Sulawesi, Indonesia

Number and price of bushmeat sold in several traditional markets in North Sulawesi, Indonesia

The selling price of bushmeat in 11 traditional markets did not differ significantly; however, the types and quantities varied substantially. During the interview process, not all respondents were willing to provide data. This unwillingness stemmed from the belief that businesses such as hunters, collectors, and bushmeat traders would face monitoring and restrictions from the authorities or government. Meanwhile, these individuals rely on bushmeat trading to support their families and meet basic needs. Through personal interviews and communications, this study gathered data on the number of hunts and prices for each type of wild animal from April to September 2024 from a trader in Imandi, who collected information on the results of hunters' efforts around the plantations and forests of Dumoga, Imandi, and Ibolian Villages in Bolaang Mongondow District (Table 1). Additionally, there was a trader/collector in the Amurang Market who sourced bushmeat from four suppliers outside the North Sulawesi area. Based on our interviews, it was shown that the highest price of bushmeat was recorded during the Thanksgiving holidays for some communities in June and August 2024, while the lowest prices were observed in April, May, and July 2024.

Conservation status of traded species and efforts to conserve wild animals

The conservation status of traded bushmeat species in 11 traditional markets in North Sulawesi, according to the IUCN Red List, includes the wild boar (*S. scrofa*), which is classified as of least concern (Keuling and Leus 2019). Bat species such as *P. alecto*, *D. exoleta*, *N. cephalotes*, *R. celebensis*, *R. amplexicaudatus*, and *T. nigrescens* are also listed as least concern (Tsang 2016; Roberts et al. 2017; Hutson et al. 2019; Waldien et al. 2019; Wiantoro et al. 2020a, b). *A. celebensis* is classified as vulnerable (Sheherazade et al. 2022), while *S. wallacei* is regarded as near threatened (Sheherazade 2021). The waders *G. philippensis* and *G. torquata* are of least concern (BirdLife International 2016, 2018), as is the python *M. reticulatus*

(Stuart et al. 2018). The cuscus species *S. celebensis* is near threatened (Helgen et al. 2020), and *A. ursinus* is classified as vulnerable (Salas et al. 2019). *Rattus argentiventer* is of least concern (Ruedas and Aplin 2016). *Strigocuscus celebensis* is also protected by the government under Regulation of the Indonesian Minister of Environment and Forestry

Number P.106/MENLHK/SETJEN/Kum.1/12/2018. Moreover, some traded species, including the python and fruit bats (*P. alecto* and *A. celebensis*), are also listed in the CITES Appendix II, meaning they are currently not threatened with extinction but may become so without trade controls. Based on monitoring results conducted over six months, it can be concluded that not all traditional markets sold animals such as monkeys, hog deer, and dwarf buffalo, which are protected by Indonesian government regulations. However, trade in animals from the Suidae, Pteropodidae, Muridae, Phalangeridae, Rallidae, and Pythonidae families was still found.

The results showed significant variation in the types of bushmeat sold across various markets. However, the trade of wild animals and their meat for consumption in North Sulawesi has continued unabated for the past three years. This highlights the need for conservation efforts to protect animals in their habitats by educating hunters, collectors, traders, and students, who are still limited in number, particularly in a few schools. Government intervention plays a vital role in safeguarding animals, particularly the endemic species of Sulawesi. This was evident during the study, where protected animals, typically hunted, such as anoa, monkeys, and babirusas, were not found. In several traditional markets, boards have been erected to raise awareness about the types of protected animals. Furthermore, no bats were found in the Bersehati and Pinasungkulan Markets in Manado City, since much news and information about extreme food in these markets has been reported via social media platforms. In addition, strengthening the border patrol to control the hunting and bushmeat trade across the provinces is also needed as another intervention.

Table 1. Number and price of bushmeat in several markets in North Sulawesi, Indonesia

Market	Animals	Price (IDR)	Amount
Dumoga, Imandi, and Ibolian	Wild boars	75,000-90,000 per kg	18 individuals
	Bat (bigger size, 200-300 grams)	100,000 per 3 individuals	1,295 individuals
	Bat (small size, under 200 grams)	50,000 per 8 individuals	9,778 individuals
	White-tailed forest rat	20,000-35,000 per individual	6,154 individuals
	Black-tailed forest rat	10,000-20,000 per individual	2,504 individuals
	Weris bird	20,000-25,000 per individual	1,435 individuals
	Monitor lizards	150,000-200,000 per individual	4 individuals
	Snake (Python)	40,000-60,000 per kg	5 individuals (body length 6-8 meters)
Amurang	Wild boars	80,000-95,000 per kg	9,953 kg (about 332 individuals)
	Bats	85,000-95,000 per kg	4,192 kg (about 8,384-12,576 individuals)
	Snake (Python)	60,000-65,000 per kg	395.5 kg (about 9-10 Individuals)

The ecological balance of these animals' habitats will be disrupted and threatened if hunting continues unchecked. This phenomenon poses a risk to the forest ecosystem, as wild animals play a crucial role in maintaining the ecological cycle, acting as seed dispersers, pollinators, and forest cleaners. Due to the high volume of bushmeat traded at Imandi and Amurang Markets, where selling prices are very attractive to meet the economic needs of hunters, collectors, and traders, the exploitation of wild animals is likely to persist. This situation needs to be addressed by policymakers through solutions that are profitable for hunters, collectors, and bushmeat traders. Awareness campaigns that fail to offer solutions are unlikely to yield the desired results. Prohibitions based on government regulations will impact hunting practices, although hunting may still be conducted covertly. Integrating conservation education into the curriculum for early childhood through to high school should be considered to break the cycle of hunters and consumers of bushmeat. Additionally, creating jobs for wildlife hunters also warrants consideration. Despite current data being recorded, further studies such as monitoring wild animal hunting and the bushmeat trade, assessing the socio-economic impact of the bushmeat trade, and conducting zoonotic surveillance are crucial. These will provide updated information and an assessment of the current situation to measure the effectiveness of the conservation efforts intervention.

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