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Human interaction with bats in Batu Putih Village Tangkoko North Sulawesi and the zoonosis risk

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Abstract. Bats are a reservoir for zoonotic diseases. Human interactions with bats such as living on the edge of the forest, hunting and consuming their meat have the potential to cause new diseases. Research has been carried out to obtain contact information for humans and bats in the village of Batuputih Bawah, on the border of the Tangkoko forest North Sulawesi. The data and information were obtained through obsevations and interview with the residents that had bat food trees in their yards. Based on observations, Species of bats that visit the house yards are *Thoopterus nigrescens, Cynopterus minutus , Nyctimene cephalotes, Rousettus celebensis, , Macroglossus minimus*. 30 home *yards have fruit trees which are food for bats (Mangifera indica (100%), Musa sp (83.3%), Carica papaya (50%), Nephelium lappaceum* (30%), *Psidium guajava* (5%), and *Artocarpus altilis* (5%). 20 houses have palm trees (*Arenga pinnata*) on their back yards. 10 houses have *Terminalia catappa* trees. Bats are mostly seen before sun-down. The results of the interview showed that falling fruits with bat bites are collected and used as animal feed. It can be concluded that there is a high interaction between human and bats in Batu Putih Village Tangkoko and they are at risk of zoonosis from bats. Education and an integrated system are needed for managing the health of forest fringe communities who have close contacts with bat.
Keywords: bat, zoonotic, North Sulawesi

1. Introduction

Batuputih is a village located on the beach and directly adjacent to the Duasudara Mount conservation area, North Sulawesi Province. This village is known as a tourist village because it has beautiful beaches and as a place to stay for tourists visiting the Nature Tourism Park (NTP). The Batuputih NTP area is one of the habitats for various endemic animals of Sulawesi Geographical location adjacent to the forest, especially settlements adjacent to the area, is generally subject to disturbance by wild animals that come looking for food. This incident caused conflict and interaction between the population and wildlife. The residents must be aware of this interaction given the potential for exposure to diseases originating from wild animals, especially from bats.

Various types of wildlife such as bats, although they have an ecological function as seed dispersers, pollinators, and mosquito predators, they also play as reservoirs for disease. Bats are among the wild animals that have received much attention from a global public health perspective. Various infectious diseases caused by viruses such as Ebola, Marburg, Nipah, Severe Acute Respiratory Syndrome (SARS) Co-V and the Middle East Respiratory Syndromes (Mers Co-V) were zoonotic disease from bats (Ageng et al, 2017 [1]; Beena and Saikur, 2019 [4]). However, research on the impacts of wildlife diseases and interactions with livestock and ecology in relation to communities has not been widely studied (Wiethoelter et al. 2015 [15]). Therefore, this study aimed to examine how human contact with bats and to assess the risk of exposure to zoonotic diseases and to raise awareness about how to live side by side with bats.

2. Material and Methods

2.1. Location and respondents

Sampling was carried out in the yard of a resident's house adjacent to the Batuputih NTP. The number of samples was 30 residential yards. In each yard, the type and number of fruit trees that are used for bat food were identified. In the yard, the number and types of bats were also observed for 3 nights, from 06.00 PM to 06.00 AM. Observation of bats was carried out by attaching a mist net measuring 8 m long and 3 m wide. The net was installed at a height of 3 m from the ground.

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Data was also obtained through interviews with communities around the area. The interviewed respondents consisted of 10 tour guides, 7 breeders, 7 innkeepers, 5 sap processors, and 4 fishermen. Interview was conducted to obtain information about the presence of bats visiting the village, knowledge of bat nests, habit of consuming bats, and management of fruit bites. Respondents who had the most contact with bats were given knowledge about coexistence with bats. The method given was in the form of lectures and discussions at the restaurant owned by the head of the NTP Tangkoko resort using the Covid19 protocol.

This research was done by using descriptive method. Data and information were presented in narrative form and tables and figures. Conclusions was done by comparing the data and information with others research and publications.

3. Results and discussion

3.1. Types and number of bats that visit the yard

The number of bats found in this study was 42 individuals consisting of 5 types of fruit-eating bats. The types of bats found belong to the Pteropodidae family, including *Thoopterus nigrescens*, *Cynopterus minutus*, *Nyctimene cephalotes*, *Rousettus celebensis*, and *Macroglossus minimus*. The most common type of bat found was *T. nigrescens*, then *C. minimus*, while the least species of bat was *M. minimus* (Table 1). The number of species found in this study was lower when compared to the results of research conducted in the Tangkoko conservation area by Lengkong (2009)[6] which found 9 species. The average catch per night was 14 individuals with a standard deviation of 4.35 (Table 1).

Based on the data, it can be seen that there are 5 types of bats that visit and eat fruit in the yard of residents' houses. The visiting bats belong to the Pteropodidae family. According to Pillai et al. (2020)[13], the Pteropodidae family is a bat reservoir for the Nipah virus which has caused outbreaks in Malaysia, Bangladesh and India. Yang et al. (2017)[17] found the bat genus Rousettus as a reservoir for filoviruses. The genera Rousettus and Cynopterus are reported as reservoirs for the Marburg virus. *Cynopterus brachyotis* and *Macroglossus sobrinus* as reservoirs for Leptospirosis (Mulyono et al., 2018)[9].

Table 1. Number and types of bats visiting the house yard

No	Species	Repetition			Total	Average	StD
		1	2	3			
1	*Thoopterus nigrescens*	5	4	8	17	5.66	2.08
2	*Cynopterus minutus*	4	5	4	13	4.33	0.57
3	*Nyctimene cephalotes*	2	2	2	6	2.00	0.00
4	*Rousettus celebensis*	1		4	5	1.66	2.08
5	*Macroglossus minimus*	-	-	3	3	1	1.73
	Total	12	11	19	42	14.00	4.35

3.2. Types and percentages of forage trees

There were 8 types of fruit plants as bat food found in people's homes (Table 2). Fruit plants that are often found in the yard were mango (*Mangifera indica)* with a frequency of 100%. Other fruit crops were banana (*Musa* sp.), Aren (*Arenga pinnata*), Papaya (*Carica papaya*), Ketapang (*Terminalia cattapa*), Rambutan (*Nephelium lappaceum*), Guava (*Psidium guajava*) and Breadfruit (*Artocarpus altilis*) (Table 2). The average distance between the fruit trees is less than 10 meters.

Some of the plants found in people's yards that bear fruit at any time were bananas *(Musa* sp.), Sugar palm (*Arenga pinnata*), Papaya (*Carica papaya*), Ketapang (*Terminalia cattapa*), Guava (*Psidium guajava*), and Breadfruit (*Artocarpus altilis*). The fruit plants were visited by bats every day to get food as a source of energy. According to Norberg and Rayner (1987)[10], bats for their daily activities require energy from fruits, nectar, as well as fruit juice, and Sugar palm sap. *Arenga pinnata, Musa* sp, *Carica papaya* are plants that bear fruit without a certain season. It is also found in Bangladesh that bats visit home yards to eat fruits such as *Mangifera indica* and *Nephelium lappaceum* causing disturbance to

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settlements (Openshaw et al. 2016)[12]. In Australia bats visit farmlands and orchid plantations to suck nectar (Quinn et al 2014)[14].

Table 2. Types and percentage of houses planting fruit trees

No	Types of fruit trees	Percentage
1	*Mangifera indica*	100
2	*Musa* sp	83,3
3	*Arenga pinnata*	66,3
4	*Carica papaya*	50
5	*Terminalia cattapa*	33,3
6	*Nephelium lappaceum*	30
7	*Psidium guajava*	5
8	*Artocarpus altilis*	5

3.3. Roosting area

Based on interviews from tour guides, it is known that in the conservation area there were 10 roosting trees (hole trees) and 7 caves located on the edge of the beach, and several species live under the fronds of woka trees (*Livistona altissima*), a type of palm with broad leaves and under forest banana fronds. The distance between roosting area and the village was approximately 2-4 km. This fruit-eating bat has the ability to fly up to 20-50 km in search of food (Norberg and Rayner (1987)[10].

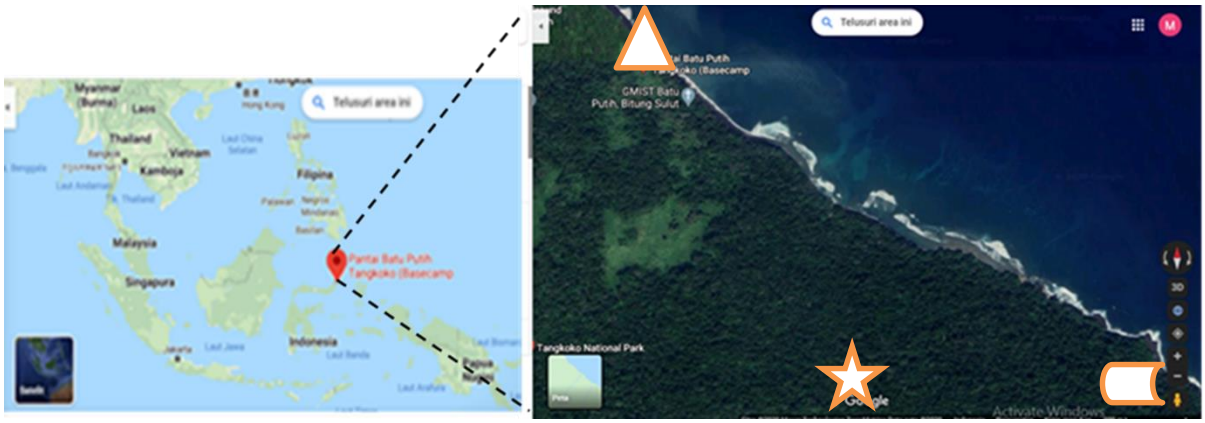

Figure 1. Roosting Area of bats in the Tangkoko Conservation Area

Batu Putih Village △ Roosting Tree ☆ Bat cave ⊂

3.4. Respondents interaction with bats

The results of interviews with respondents of pig breeders, information was obtained that the fruit damaged by bat bites was used as pig feed. Based on observations in the village, there were 5 sap processors and pig breeders who were a group that had a risk of exposure to disease from bats. In India there was an and. In Malaysia (1998-1999) there was a transmission of the Nipah virus due to livestock feeding mango bites from bats (Epstein et al, 2006)[4]. In India 2001, Bangladesh (2001-2005) there was outbreak of the Nipah virus disease caused by human contact with bats through sap water contaminated with bat saliva (Luby, 2013)[8]. According to Pillai (2020)[13], different locations have different routes of transmission. Human-bat interaction studies have become a concern in Australia regarding the Lyssa virus, including Rabies, which infects orchid flower farmers with clinical symptoms of encephalitis (Quinn et al., 2014)[14].

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(A) (B)

Figure 2. Pig cage (A), and bat-bite papaya fruit as pig feed (B)

(A) (B)

Figure 3.Nira processing farmer (A), Pig farmer (B)

3.4. Public awareness about the risk of disease from bats

Batuputih residents have interactions with bats. Public awareness aimed at reducing the risk of contracting disease from bats has been carried out in the same way as in some countries in Asia (Bangladesh, Cambodia, Lao PDR, Lao PDR, Malaysia, Myanmar, Nepal, Thailand , and Vietnam, which is a country where the population has interaction with bats using the "safe living

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side by side with bats" material through the activities of the Sam Ratulangi University partnership program (Figure 4). This material is campaign material in Asia and Africa (Francisco, 2019)[5].

Figure 4. Awareness activities about the dangers of disease from wild animals

The awareness materials about living safely side by side with bats include:

1. Reminded to avoid being exposed to bats' bodily fluids such as saliva, blood, urine or feces, and to prevent bats from living in houses or buildings (perches or "nests").

2. Not consuming food or drinking water that has been in contact with urine or bat droppings. For example, you can cover your food and drinks and don't forget to regularly wash those desserts using soap and tap water.

3. To reduce the risk of falling ill, avoid eating fruits that have been partially bitten by wild animals or livestock.

4. Don't even eat or drink something that you believe has been in contact with an animal. Do not store fruit that has been bitten by bats by removing the visible part of the bite, and do not give these fruits to your livestock. All parts of the fruit may have been contaminated and could make you sick.

5. This also applies to tapped palm sap / coconut water. Do not drink sap / coconut water that has been touched by bats. If you have no way to protect the palm sap / coconut water from exposure to bats or body fluids, make sure you don't drink it.

6. Bats often live and nest in the trees around your house. When the animals on the farm eat or rest under trees inhabited by bats, the bat urine or feces can fall on the animals' bodies and also their food. This can make them sick. If you have animals, you should find the best way to ensure that your animals eat and sleep under trees where bats are not present. Livestock should be kept away from areas where bats live. Bat manure should be handled and kept away from humans, livestock and other animals.

Before and after the training, participants in this community partnership program were given a questionnaire to measure their level of understanding of the material provided. In general, it can be concluded that the participants understand the dangers of diseases originating from wild animals. However, these activities are not sufficient to prevent the occurrence of diseases from wild animals which are highly influenced by various factors such as climate change and ecosystem changes due to habitat destruction caused by forest fires. Therefore it is necessary to integrate the decisions that drive human – environment interactions with ecological and epidemiological research in an interdisciplinary approach to understanding pathogen transmission. Moreover the policy, guidelines, biosecurity,

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biosafety needed to improve both conservation and disease spread outcomes. This is in line with what Van Der Poel et al,(2006)[15] stated that awareness of the dangers of disease emergence from bats needs to be done in Europe through surveillance activities for early detection of the dangers of disease emergence. In Malaysia, research on Knowledge, Attitude and Practice on Bats-Borne Diseases among Village Residents was conducted on 100 respondents with questions related to knowledge of diseases in bats showed raise awareness about rabies in bats was the most important for mitigation zoonotic diseases(Nurul, 2018)[11]. In Australia, awareness raising has been made on orchid flower farmers. In addition, studies were also carried out to evaluate the effectiveness of awareness raising activities and to evaluate the effectiveness of awareness-raising communications related to content and delivery methods (Quinn et al. 2018)[14]. In China, which is the first country of the COVID-19 pandemic, studies have been carried out on various risk factors for zoonotic diseases in South China in rural communities who live side by side with domestic animals and livestock. The results of the study concluded that behavior change is the main key in the prevention of zoonotic diseases (Lia et al, 2020)[7].

5. Conclusion

The interaction between humans and bats in Batuputih village is high and there is the potential for human wildlife disease to occur. The most high risk zoonosis is the house has variety fruits (palm tree, papaya, banana). The most high interaction and risk is sugar palm and pig farmer. Continuous monitoring steps are needed to determine whether the awareness that has been carried out can change the behavior and culture of consuming wildlife. In addition, the people of Batuputih Village need the support of a good and well health system that is fast and accurate, so that the incidence of wildlife disease to humans can be prevented, such as an early warning system for wildlife disease incidents by the government that must be developed and implemented. Research on the identification of pathogens in wild animals is important for surveillance of zoonotic diseases.

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7. Conflict of interest

The authors declare that there is no conflict of interest.

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