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Monitoring of Togeanensis Babirusa (*Babyrousa togeanensis*) Population in Togean Islands National Park

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ABSTRACT

Babyrousa togeanensis is an endemic wildlife of Sulawesi Island, Indonesia. Government development programs and the increased activities of local communities in the Togean Islands National Park area are causing this animal habitat to be narrowed. Monitoring the *Babyrousa togeanensis* population is crucial to updating their numbers in protected areas to avoid extinction. This study used direct and indirect observation methods to investigate the Babirusa population at Urulepe Point, Togean Island. Our study showed that the total population of Babirusa individuals in the study coverage area was 58 individuals per km^2, higher than the number reported in the previous year. The increase in the number of Babirusa populations can be assumed to have occurred due to increased awareness of local people about the importance of protected wildlife, as well as a piece of evidence that conservation by the government through the TNKT has been successfully implemented. Environmental conditions in TNKT are good enough to support the habitat and needs of life and breeding of Togean Babirusa. The most effective method of monitoring Babirusa was camera traps because the wildlife avoids humans, making the direct transect strip method less effective for encountering Babirusa.

Keywords: Babirusa, camera trap, monitoring, strip transect, Togean Islands National Park

INTRODUCTION

The Togean Islands National Park in Indonesia covers an area of 362,605 hectares and contains various ecosystems with rich biodiversity. It has been a protected area since 2004 (Dali et al., 2023). One of the important species of biodiversity found in the park is the Babirusa (*Babyrousa togeanensis*), which is endemic to Sulawesi (Rosyidy, 2020; Jati et al., 2024;) and several small neighboring islands, including Togean, Sula, and Buru. The distribution of Babirusa has significantly decreased due to habitat loss caused by development. Babirusa can only be found in a few areas, such as Lore Lindu National Park, Morowali CA, Luwuk, Balantak, and the Togean Islands. In the Togean Islands, Babirusa is distributed across the Malenge, Talatakoh, Togean, and Batudaka Islands.

Babirusa conservation is threatened by habitat loss and poaching activities aimed at selling their meat to local markets. Additionally, government development programs, including clearing and creating new land, pose a significant threat to their survival (Kiroh, 2020; Rosyidy, 2020). In the Togean Islands, Babirusa populations are declining due to several factors, such as habitat destruction hunting for food, and hunting as pests in agricultural plantations. Despite being a protected species in Indonesia since 1931 and having a vulnerable status recorded by

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the International Union for Conservation of Nature (IUCN) since 2008, Babirusa meat is still traded in traditional markets in Sulawesi (Leus & Macdonald, 1997; Kiroh, 2020). It is crucial to preserve Indonesia's native animals to ensure their sustainability and prevent them from becoming endangered. Currently, there is a high demand for Babirusa to be conserved. Therefore, to ensure the successful conservation of Babirusa and other wildlife species, it is crucial to maximize appropriate conservation measures such as habitat management and prevention of poaching. The availability of adequate and up-to-date population and habitat data is one of the primary keys to successful conservation (Rosyidy, 2020). Decisions to increase or reduce populations for sustainability purposes should depend highly on the latest available data.

To determine the latest developments in Babirusa population numbers, habitat conditions, and distribution, it is necessary to conduct Babirusa monitoring. Babirusa monitoring involves the repeated observation of Babirusa in a certain area to determine the number of Babirusa populations, habitat conditions, and distribution of these wild animals, whether stable, increasing, or decreasing. However, an inventory of Babirusa wildlife must first be conducted before monitoring Babirusa populations. The data obtained from the wildlife inventory can serve as a foundation for monitoring wildlife, allowing for the collection of information on species development over time.

In 2017, the Togean Islands National Park (TNKT) conducted a Babirusa wildlife inventory on Togean Island. This was based on information received from locals who said that on Talatakoh Island, Babirusa often enters people's farms. This could be due to the narrowing of the Babirusa's native habitat in the area. The results obtained from the inventory were data on population size, habitat condition, and distribution of Babirusa on Batudaka Island, Togean Islands National Park.

To assess the level of Babirusa population development, Babirusa population monitoring activities were conducted in 2018 and 2019. However, due to budget refocusing, Babirusa monitoring activities were limited to one location in 2019, whereas previously two locations were monitored yearly. In 2020, Babirusa monitoring activities were carried out solely on Togean Island. In 2021, monitoring activities were once again conducted on Talatakoh Island. However, monitoring activities will be conducted in two locations in 2022: Talatakoh Island and Togean Island. Additionally, Babirusa monitoring was conducted again in the Togean Island area to obtain the latest data and information on Babirusa populations and distribution. This scientific article aims to evaluate Babirusa's population, habitat, and distribution in the Togean Island area of TNKT. The study's results provide information on Babirusa's current population and distribution in Togean Island. This information can be used to inform the management of the TNKT conservation area.

MATERIAL AND METHOD

Location and Time of Research

Togean Island comprises 229.52 km^2 and encompasses 18 villages. The island is predominantly located within the sub-district and is the largest. Figure 1 is the map of Togean Island that has been selected for monitoring activity. The region experiences a tropical marine climate. From 9 December 2023 to 13 December 2023, Babirusa (*Babyrousa togeanensis*) monitoring was conducted at Urelepe Point, Togean Island, National

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Park Management Section Region II Lebiti, covering an area of 100 ha.

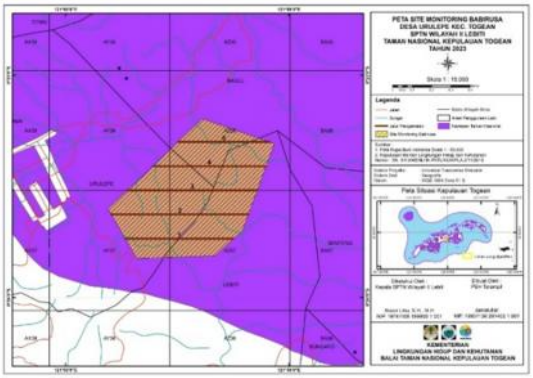

Figure 1. The site's location for Babirusa monitoring in Urulepe, Togean

Tools and Materials

Togean Babirusa monitoring activities that have been conducted have utilized several tools such as area maps, global positioning systems (GPS), digital cameras, trap cameras, observation tables to record data, clipboards, and binoculars.

Research Procedure

Before conducting field monitoring, a literature study was carried out to gather data and information on the general habitat conditions, bio-ecology, distribution, and population of Babirusa. Following this, observations were made using the strip transect method (Ostrand et al., 1998), with path coverage adjusted to the topography and stand density of the monitoring location. Data collected from field observations were based on direct encounters with the target species, Babirusa, on observation strips. The pattern of strip transects conducted in this study can be seen in Figure 2. Babirusa monitoring activities in the Togean Islands region in November 2023 were conducted in five transect lines, each with a length of approximately 1,000 m and a width of 50 m on both sides. These transect lines are shown in Table 1.

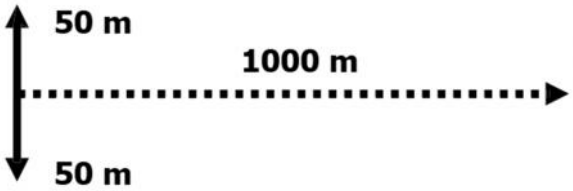

Figure 2. Strip transect pattern

Table 1. Total of transect sites and their locations selected for Babirusa monitoring

No. Jalur Transek	Titik Koordinat	
	Longitude	Latitude
1	121°58'12,6229"E	0°23'5,4634"S
2	121°58'12,6214"E	0°23'13,5152"S
3	121°58'12,6219"E	0°23'21,5307"S
4	121°58'12,6238"E	0°23'29,5671"S
5	121°58'12,6288"E	0°23'37,7353"S

The study area or statistical population size was set at 200 hectares per site, based on the home range of a Suidae family wart hog from Zimbabwe, which is between 64 and 374 hectares. The sample population size, or sampling intensity, was set at 10% of the statistical population size. The observer's walking speed was held constant at ± 1 km/h. When Babirusa was detected, observers took 5-10 minutes to confirm their position (inside or outside the transect) and the number of Babirusa (groups and individuals) and recorded the data on a sheet. Data collected for density estimation using the strip transect method includes the number of groups and group size (number of individuals in a group) (Coburn et al., 2008). Additionally, the position of Babirusa was recorded horizontally (according to the longitudinal direction of the transect) and vertically (height of Babirusa above the tree). The data collection techniques employed in the field were:

1. Directly: conducted based on direct encounters with animals and in pre-surveyed areas of animal presence.

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Direct data collection is applied to Babirusa monitoring using the strip transect method. Data collected included species found, number of individuals, sex (if known), number of individuals by age class (adults, juveniles, and children), time encountered (hours, minutes), solitary/group social characteristics, direct or indirect encounters, and simple descriptions of habitat conditions where animals were found. In this method, camera traps were also installed following previous research methods (Andreas et al., 2018).

2. Indirect monitoring: conducted based on encountering distinctive signs left by Babirusa. Tracks found are photographed and stored to help strengthen monitoring. These signs include feeding marks, scratch, and burrow marks, hair marks, tracks, and nests.

Babirusa density calculations are typically expressed in units of groups per area (km^2 or ha) due to their group living habits. To convert the estimated group density into individuals per area, the group density value is multiplied by the average group size (Caughley, 1994; Nijman, 2004). Population density calculations only include group data consisting of two or more individuals. The following section describes how estimated Babirusa population density values are calculated based on observations from each monitoring method.

Calculation of Babirusa population density estimates using the probability proportional to size sampling equation (Caughley, 1994).

$$\hat{D} = \frac{1}{n} * \sum \frac{y_i}{a_i}$$

Description:
$\hat{D}$ = estimated value population density (groups/km^2)
yi = number of groups detected within the i-th transect
ai = area of the i-th transect (km^2)
n = number of transects

Babirusa population density in units of individuals/km2 was calculated using equation 2 (Caughley, 1994):

$$\hat{D}_i = \hat{D} * \bar{x}, \ \bar{x} = \frac{\sum x_i}{Y} \qquad (2)$$

Description:
$\bar{x}$ =average group size (individuals/group)
Xi = number of individuals in the i-th group
Y = total number of groups observed

RESULT AND DISCUSSION

The Babirusa species observed during the population monitoring in the Togean Islands in December 2023 was the Togean Babirusa (*Babyrousa togeanensis*).

The results of the Babirusa monitoring data on Togean Island are presented in Table 2. The estimated population density was calculated using a formula, and the Babirusa population density was 12 groups per km^2. The population density of Babirusa was calculated as 58 individuals per km^2. A report on Babirusa population monitoring in the Urulepe Village area from 2017 to 2023 can determine the total estimated population on Togean Island (Table 3). The trend of Babirusa population observations from 2017 shows that the population is stable from year to year. However, it is noteworthy that the Babirusa population increased from 54 to 58 individuals per km^2 in 2023.

Table 2. Number of Babirusa encountered in five transect sites

Site No.	*n* Population	Population Structure			
		Male	Female	Pups	Total
1	1	1	2	3	6
2	1	1	2	3	6
3	1	1	2	1	4
	2	1	1	1	3

4	1	1	2	2	5
5	1	1	1	3	5

Table 3. Babirusa population from 2017 to 2023

Year	Individu per km^2
2017	53
2018	54
2019	55
2020	63
2021	Not Defined
2022	54
2023	58

We found many indirect encounters with Babirusa during the observations, including tracks and wallowing places. Babirusa tracks were identified in the Togean island region (Urulepe Village) as footprints and rubbing (Figure 3). These tracks were found on all observation trails and at altitudes 10-100 meters above sea level (masl). The identification used to distinguish between Babirusa tracks and those of other animals was based on the shape of Babirusa's feet. Babirusa feet tend to be rounder than those of other animals.

(a) (b)

Figure 3. Indirect observation of Babirusa monitoring (a) footprints and (b) scuff marks

Ponds that appear to be still active can be found on observation paths 1, 2, and 3 in the Urulepe Village area. In contrast, observation tracks 4 and 5 have one pit each. Babirusa wallowing sites were found at 10-100m above sea level during the activity (see Figure 4). The identification of Babirusa wallowing sites relied on second-hand accounts from individuals who had observed Babirusa wallowing in the region, as well as the findings of the Babirusa monitoring team's investigations.

(a) (b)

Figure 4. Indirect observation of Babirusa monitoring at site 3 (a) puddle 1 and (b) puddle 2

In addition, installing camera traps on observation trails is a very effective method for monitoring Babirusa. This is related to the nature of wildlife, which tends to be shy towards human presence. Based on the camera trap results, the sex of the Babirusa captured by the camera can be differentiated based on their morphology (Figure 5). The camera traps also captured images of a group of Babirusa that can be assumed to be a family consisting of a female and several large chicks (Figure 6). This is an interesting finding in terms of wildlife behavior.

(a) (b)

Figure 5. Babirusa snaps from camera trap (a) male and (b) female

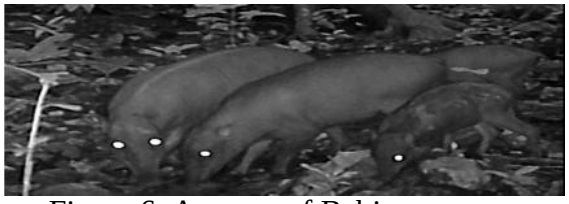

Figure 6. A group of Babirusas snaps from a camera trap

The estimated increase in the Babirusa population in 2023 may be attributed to greater awareness of animal conservation among people in the surrounding forest area. However, not all individuals are informed about it. Community awareness plays a crucial role in supporting the existence of Babirusa. In 2023, the estimated Babirusa population increase may be attributed to routine forest area security activities conducted by the Togean Islands National Park. Frequent patrols to secure forest areas will limit opportunities for unscrupulous individuals to destroy Babirusa's habitat and hunt these animals. Several factors can influence the monitoring of Babirusa populations, including The factors that can affect Babirusa populations include human activity, hunting for consumption or trade, the frequency of Babirusa births, the selection of observation sites, the length of time the activity is carried out, weather conditions/seasons when the activity is carried out, and topography.

The population monitoring of Babirusa on Togean Island now includes camera traps in addition to the strip transect method. The strip transect method is cost-effective for monitoring wild animals (Ogutu et al., 2006). Statistically predetermined monitoring areas are highly effective when used over a long period (Durant et al., 2011). Installing camera traps along the strip transect aims to reduce high bias values and achieve more optimal results. No changes in content have been made. Camera traps are remote devices equipped with motion sensors that are beneficial for wildlife conservation and monitoring the populations of various species that are typically difficult to find and study, including Babirusa. Bismark (2011), describes the camera trap method (camera-trapping) as a technique for monitoring wildlife without observers, such as tigers. This method has become popular for monitoring species diversity in the wild (Wahyudi & Stuebing, 2013; Radinal et al., 2019). Camera trap methods can provide a range of data, including the number, gender, estimated age, and behaviors of animals. This data can be useful for further study, such as investigating food hunting and nest-building behaviors (Fragoso et al., 2019).

To determine the gender of Babirusa during the monitoring process, observe the presence of tusks (Macdonald & Shaw, 2018). Female Babirusa do not have tusks protruding from both sides of their mouths, while males have relatively larger body sizes and may appear larger than other pig species. The observed individuals suggest that Babirusa reproduction has occurred despite habitat narrowing. The physical condition of the Babirusa is considered healthy and active. The results indicate that Babirusa moves in groups, assumed to consist of adult females and their offspring. Patry et al. (1995) found that male Babirusa typically live solitarily, while female Babirusa live with their offspring until they reach maturity.

Based on the obtained data, the population of Babirusa on Togean Island is relatively abundant. However, their conservation requires extra attention, particularly in preserving their lowland tropical rainforest habitat. Babirusa prefers forest areas with flowing rivers, water sources, swamps, and flowing water that enable them to obtain drinking water and wallow. Babirusa regularly visits water sources and salt licks to obtain necessary mineral salts that aid digestion (Patry et al., 1995; Ito et al., 2017). They exhibit highly organized and specific nesting behaviors, carefully considering even the materials for their nests (Ito et al., 2019). Observations suggest that the Babirusa habitat on Togean Island adequately fulfills the requirements for their survival.

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The availability of food in Babirusa's habitat is also an important consideration. However, the identification of Babirusa food remains uncertain due to limited observational data on their feeding behavior and food choices in nature (Leus & Macdonald, 1997; Clayton & MacDonald, 1999; Leus et al., 1999). Leus (1999) recorded a list of plant species, including palmae, that grow in Sulawesi and produce the fruit Babirusa feeds on. Babirusa's main food consists of various types of fruit, such as dongi (*Dillenia ochreata*), Rao (*Dracontomelon Rao*), sweet potatoes, mushrooms, and Pangi fruit (*Pangium edule*). Babirusa also likes tubers and bamboo shoots (Ito et al., 2017). According to Patry et al. (1995), Babirusa has strong fangs and teeth that break hard nuts easily. In addition, natural forests in Sulawesi provide seeds such as walnuts and chestnuts, as Leus et al. (1999) noted. They are often observed wallowing and visiting mineral-rich water sources, similar to pigs. Babirusa are omnivorous and consume plants and small animals, such as fish, birds, and insects in small quantities. Babirusa occasionally scavenge fallen trees for sources of animal protein, such as caterpillars or worms (Koesdarto et al., 2011), or prey on small animals like larvae, worms, or caterpillars (Clayton & MacDonald, 1999). In conservation institutions, adult Babirusa also hunts small mammals and birds.

Based on observations, the environmental conditions on Togean Island remain a highly potential habitat for Babirusa. This is due to the availability of various types of food, including palmae plants, rao fruit, bamboo shoots, and more, in the forest areas of Talatakoh Island and Togean Island. The Babirusa population and habitat on Talatakoh Island and Togean Island are in good condition. The animals are within the area's carrying capacity, and the population is stable. To maintain this, conservation efforts should focus on securing the area and preserving the health of the animals and their habitat. Security measures should primarily address the threat of animal hunting and habitat destruction. Meanwhile, it is also necessary to maintain animal health to prevent disease outbreaks that could endanger the surrounding community. To support the government's efforts, it is hoped that the public will become more aware of the need to protect and preserve the Babirusa animal and its natural habitat to prevent Babirusa animal extinction.

One potential improvement based on the findings of this research is to increase public awareness, particularly among locals living near Babirusa's natural habitat, about the significance of preserving this wild animal. The latest Babirusa population figures, provided periodically, can be used as persuasive material to encourage local communities to participate in the protection of this endemic wild animal in Sulawesi. To achieve this, BTNKT could create a conservation-based outreach program for communities around the Togean Islands, highlighting the importance of preserving protected wild animals.

CONCLUSION

Although the habitat of the Togean Babirusa is considered to be narrowing, the population found in the Togean Island area in 2023 is still relatively high and has increased compared to the previous year. This increase could indicate increased awareness among locals about the importance of conserving protected wild animals and the successful functioning of the Togean Islands National Park as a protected area. The environmental conditions in the TNKT area remain suitable for supporting the life and

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breeding of Babirusa. This is primarily due to the availability of various types of natural food for these animals.

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