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Abstract

Anoa, a tiny buffalo endemic to the Indonesian island of Sulawesi (and surrounding offshore islands) is the largest wild terrestrial mammal in Sulawesi. It is protected by the Government of the Republic of Indonesia, categorized as Endangered (EN) based on the IUCN Red List of Threatened Species, and included in Appendix I according to the Checklist of CITES Species. Information about the area occupied by anoa is needed and important for conservation efforts, particularly in dealing with potential threats to the population decline of this animal. This study aims to determine the level of anoa habitat occupancy and environmental factors that affect anoa habitat occupancy in the Dako Mountain Nature Reserve, Tolitoli District, Central Sulawesi, Indonesia. The occupancy area of Anoa was surveyed directly at 10 study sites of ca.400 ha each and indirectly by using six camera traps on 6 sites. The data was analyzed using a species occupancy model while the environmental factors influencing the occupancy area of anoa were analyzed by using the PRESENCE software. From 10 sites of direct surveys, anoa was detected in 7 sites. Meanwhile, from a camera trap method anoa was recorded occupying four of six sites. The three best environmental factors positively correlated with occupancy area indicate that anoa prefers areas that are far from cultivated areas and roads and has extensive primary forest cover. The closest distance between the cultivated area and the road where anoa was detected was 1.329 meters and 2.051 meters, respectively while the minimum forest vegetation cover in which anoa was detected was 22.9%. Therefore, these three factors need attention from stakeholders in the conservation planning of this endemic animal..

Keywords : Endemic buffalo, Occupancy area, Environmental factors, Sulawesi, Species Occupancy Model.

INTRODUCTION

Anoa is dwarf buffalo, endemic to the Indonesian island of Sulawesi (and surrounding offshore islands), but is the largest wild terrestrial mammal on Sulawesi. Two species are currently recognized, the lowland anoa (Bubalus depressicornis) and the mountain anoa (Bubalus quarlesi) (Groves, 1969). Solitary life and a smaller body are one form of adaptation of animals in forested habitats with complex geological and physical conditions because it will be difficult for large animals and groups to move freely in forest habitats with varied ecosystem topography (Mustari, 2019).

Anoa is an important species for conservation, as the largest endemic wild mammal on Sulawesi island has high biodiversity. Habitat destruction and hunting anoa cause population decline, resulting in the extinction of this animal. The threat of deforestation that causes damage to anoa habitat occurs in Central Sulawesi, including Tolitoli District. Based on data, the deforestation that occurred from 1990 to 2016 in Tolitoli District was 73.223 hectares or an average of 2.816 hectares per year, with a deforestation rate of 1.19% per year (Rosa, 2018). Rejeki et al. (2018) stated that Anoa was hunted or captured by as many as 283 individuals in one year. The highest hunting rate was recorded in North Sulawesi Province (34%), followed by Southeast Sulawesi (30%), and then Central Sulawesi (22%); in these provinces, it was identified that certain species were hunted as commodities to generate income.

Regarding the abundance of the Anoa population, there needs to be more data or information to accurately measure the abundance of the species at this time. However, Anoa is still relatively widely distributed within the currently known range in Sulawesi. It is estimated that the population sizes of the two anoa species are less than 2.500 of adults. It is estimated that no subpopulations exceed 250 mature individuals, even in large protected areas (e.g., Lore Lindu National Park) and other large forest blocks (Burton et al., 2016). Efforts to protect and preserve the Anoa have been carried out to protect the anoa species from extinction. In addition to designating it as a protected animal, the government also established anoa habitat to be protected as a conservation area. One of Anoa's natural habitats is the Dako Mountain Nature Reserve based on the Decree of the Minister of Forestry and Plantations Number: 238/Kpts-II/1999 dated 27 April 1999, covering an area of 19.590.20 hectares.

The area occupied by a species is an important variable for conservation. For example, the IUCN uses changes in species-area and distribution to guide listings for changes in species status on the Red List. In addition, the USGS uses occupancy in several national and regional monitoring programs (O'Brian et al., 2015). Therefore, it is important to conduct this research to provide information for the needs of long-term management of anoa species in the Dako Mountain Nature Reserve. The formulations of the problems of this study are: (1) what is the percentage of occupancy area of Anoa (Bubalus spp) habitat in the Dako Mountain Tolitoli Nature Reserve?. (2) what environmental factors affect the habitat occupancy of Anoa (Bubalus spp) in the Dako Mountain Nature Reserve, Tolitoli District?. The aims of this study are to (1) calculate the percentage of occupancy area of Anoa (Bubalus spp) habitat in the Dako Mountain Nature Reserve, Tolitoli District. (2) determine environmental factors that affect the habitat occupancy of Anoa (Bubalus spp) in the Dako Mountain Nature Reserve, Tolitoli District.

RESEARCH METHODS

This research was carried out from February to November 2021 in the Dako Mountain Nature Reserve, Galang Subdistrict, and Baolan Subdistrict, Tolitoli District. The survey was conducted directly on 10 research grids covering an area of 3.483 hectares, each measuring 2.000 m x 2.000 m (400 ha). In addition, the survey was also conducted with camera traps on 6 research grids that were passed during the direct survey.

Data Collection Technique

1. Direct Survey

Each sample unit/grid with a unique identity is surveyed on foot to look for the presence of the target animal by direct encounter or animal tracks (footprints, droppings, friction (body and horns on trees), food scraps, and others). The survey was conducted by tracing the sample path. Every 1 km traced along the sample path is made a segment. The minimum number of replications in each sample unit or grid is 5 x 1 km. The 1 km trip measurement is based on a combination of GPS readings and 3D length measurements based on regional DEM data with ArcGIS software. The survey paths follow existing animal paths or topography, such as hill or mountain ridges
, to maximize the probability of getting anoa trails or direct encounters.

2. Survey with camera trap

Wildlife observation techniques are carried out using camera traps for animals that have elusive behavior from humans. The camera operating in the field for large mammals is about ninety days, with the duration between the first camera being installed and the last camera being taken not more than 3 (three) months. This should be done to ensure that the assumption of a temporally closed population is not violated so that the effects of birth/death and immigration can be ignored (Ditjen PHKA, 2014). Anoa occupancy survey using camera traps in this study considers the number of camera traps available. Therefore, the number of camera units will determine the number of points installed in the field. The survey design with camera traps follows the sample unit (grid) that has been made, where 1 (one) sample unit/grid 1 location of camera traps is installed with a single camera (not facing each other).

3. Environmental Covariate Measurement

The environmental covariates measured were distance from roads, distance from cultivated areas, distance from settlements, presence of water sources, forest cover, and slope and altitude. All environmental covariate variables were analyzed through ArcGIS software to get the closest distance from each grid or sample unit.

Data analysis

The data obtained from the survey activities were then analyzed using the species occupancy modeling method (MacKenzie et al., 2002; MacKenzie et al., 2006). This method is an estimation method using presence or absence data by taking into account the possibility of detecting the proportion of areas inhabited by animals with a detection probability of less than one for analysis of anoa occupancy and the factors that influence it using the PRESENCE application (USGS, 2021). This study uses single species single-season occupancy modeling because this model is the simplest and most often used.

The proportion of the use of the Anoa area in all sample units (grid) is calculated by calculating the naive occupancy probability value. For example, psi (Ψ) estimation with the assumption that the detection probability (p) is perfect or with a value of "1" is called a naive occupancy estimate, with the following equation:

$$Psi(\Psi) = x/s$$

Description:
Ψ = naive occupancy estimateby animals
x = the number of sample units (grids) where the presence of animals is detected at least once.
s = total of all surveyed grids

MacKenzie et al. (2002) present a model for estimating the site occupancy probability of a target species in situations where the species is not guaranteed to be detected even while at a site. Let the probability that a site is occupied and p[j] is the probability of detecting a species in the survey, given that the species is at the site. They use probabilistic arguments to describe the detection history observed for a site through a series of surveys. For example, the possibilities for observation 1001 (which indicates that the species was detected in the first and fourth surveys on site) are:

$$\Psi \text{ x } p[1](1- p[2])(1-p[3])p[4].$$

Description:
Ψ = naive occupancy estimateby animals
p = detection probability
[1] = 1st survey etc

Meanwhile, the probability of never detecting a species at a location (0000) is:

$$\Psi \text{ x } (1-p[1])(1- p[2])(1-p[3])(1-p[4])+(1-\Psi)$$

Data were analyzed to determine the environmental factors that affect the habitat of anoa occupancy in the Dako Mountain Nature Reserve. Parameters for detecting the presence of Anoa will be estimated using the Maximum Likelihood-based Technique developed by MacKenzie (2006). The model ranking will follow the Akaike Information Criterion (AIC) numerical model. The model tested is based on the variables taken in data collection: distance from roads, distance from cultivated areas, distance from settlements, availability of water sources, forest cover, elevation, and slope. Therefore, the model with the smallest AIC number and the fewest parameters is the most appropriate model to describe the data. This analysis can describe the distribution of Anoa in the Dako Mountain Nature Reserve in the form of the influence of environmental covariates on the proportion of the area used by animals in the research location (Sodik et al., 2019).

RESULT AND DISCUSSION

Anoa's Encounter and Camera Trap Results

Observations by direct survey explored 10 grids (sample plots) measuring 2 x 2 km (400 hectares) of the 62 grids in the Dako Mountain Nature Reserve. This observation

has covered a distance of 51 km during the effective time of the survey, with a home range of 3.483 hectares out of 19.590.20 hectares of the entire Dako Mountain Nature Reserve (Figure 1.). Observations detected as many as 14 anoa findings or replications where there were signs of Anoa during the survey period. The findings of the anoa sign consisted of 8 footprints and six feces. No anoa was found directly during this observation, only secondary findings (table 1).

Table 1. Types of anoa traces recorded in direct survey replicate

Grid	Segment	Trace Type	Size (cm)		Age		
			Length	Widht	Adult	Teen	Child
G4	S3	Footprints	6,6	6,4	√		
G5	S1	Footprints	7,6	8,3	√		
G5	S2	Feses	21,4	15,5			
G5	S3	Feces	19,8	14,2			
G5	S4	Feces	12,7	9,8			
G6	S1	Feces	13,6	10,3			
G6	S2	Footprints	7,9	8,1	√		
G6	S3	Feces	10,7	10,5			
G6	S4	Feces	16,5	10,9			
I4	S3	Footprints	6,5	7,8	√		
I5	S2	Footprints	6,1	7,5		√	
I5	S3	Footprints	6,7	6,2	√		
J2	S4	Footprints	6,9	6,6	√		
K3	S3	Footprints	7,3	8,6	√		

Description: A = Adult, T = Teenand C = Child

Anoa survey activities using camera traps in this study considered the number of available camera traps. The number of camera traps used in this study at CA Dako Mountain was 4 units, with 2 units of good camera traps removed after the installation ended. The camera traps are mounted on 6 grids, namely grids G4, G5, G6, I4, I5 and L3 (Figure 1).

The total number of photos and videos successfully collected during camera installation was 605 images, with the number of photos and videos that could capture as many as 53 images (8.76%). The number of photos captured anoa images as many as 15 images, while the number of videos captured Anoa as many as 38 videos. The number of photos capturing images of other animals and blank or damaged photos is 458. In contrast, the number of videos capturing other animals and blank and damaged videos is 94 videos.
The camera trap managed to get the Anoa animal. Some of the animals caught are male, and some are female. Anoa is seen looking for food and walks past the camera. Generally, Anoa passes camera traps at night (9 photos and 29 videos), although several times were caught during the day (6 photos and 9 videos). Anoa is an animal that is active during the day and night. In the morning, anoa begins to be active at 5.20 to 11.00, and starts to be active again at 17.00 until midnight at 00.00 and sometimes comes out again after midnight. Between this time, Anoa rests and ruminates under the shade of the forest.

Apart from anoa, there are also other animals caught by camera traps. These other animals are black monkey (Macaca hecki), wild boar (Sus scrofa), Sulawesi wild boar

(Sus celebensis), Sulawesi brown civet (Macrogalidiamusschenbroekii), babirusa (Babyrousacelebensis), rats and birds.

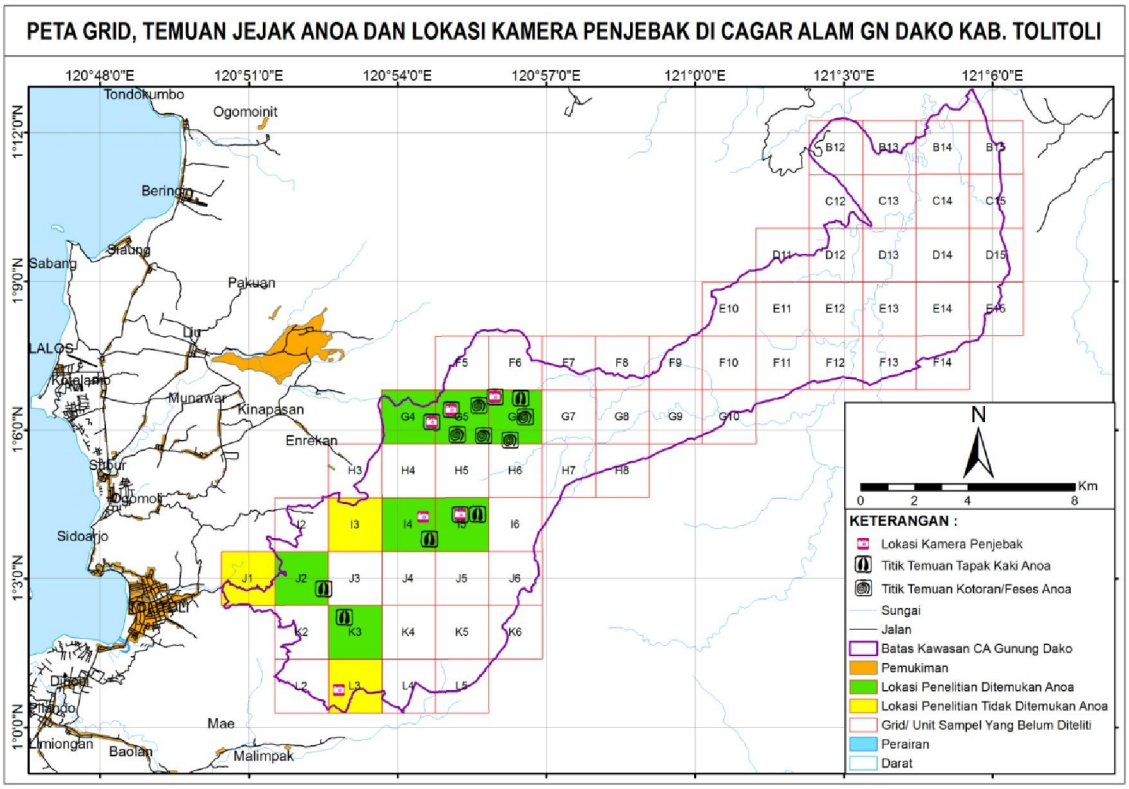

Figure 1. Grid Map, Finding Anoa Traces and Location of Camera Traps in the Dako Mountain Nature Reserve, Tolitoli District

Measurement Results of Environmental Covariates Affecting Anoa Occupancy

Distance from Road

The distance from the road is the distance of the sample plot, the distance to the location of the camera trapping location, the distance of finding traces of the closest animal to the road that can be passable by humans or motorcycles and used for human activities which can affect the presence of Anoa. The measurement results show that the average distance between the closest and furthest roads to the research location is 2.051 meters and 4.809 meters (Table 2).

Distance From Cultivation Area

The distance from the cultivation area is the distance of the sample plot, the distance to the location of camera trapping location, and the distance of finding traces of the closest animal to the cultivation area cultivated by the surrounding community (clove gardens, cocoa plantations, and other plantation/crops) as human disturbances that can affect the presence of Anoa. From the measurement results, it is known that the average distance between the nearest and furthest edges of the cultivated area is in the form of gardens (cloves, cocoa, and other plantation crops), with the research locations detected for signs of Anoa and caught by camera traps, namely 1.533 meters and 4.301 meters (Table 2).

Distance from settlement

Distance from settlements is the distance from human settlements with sample plots, location of camera trapping locations, and locations of finding traces of nearby animals, which are assumed to be human disturbances that affect the presence of Anoa. The measurement results show that the average distance between the closest and furthest settlements inhabited by humans is the closest to the research location were signs of Anoa were detected and caught by camera traps, namely 2.853 meters and 5.655 meters (Table 2).

1. Existence of Water Source

Water is a basic living thing. In general, animals will go down to the river to meet their water needs for drinking. Therefore, the presence of water sources is the distance of the sample plot, the distance from the location of the camera trapping location, the distance of finding traces of animals to the location of the presence of water sources such as rivers, creeks, springs, wallows that can affect the presence of Anoa. The measurement results show that the average distance between the nearest and farthest water sources from the research location where signs of Anoa were detected and caught by camera traps were 42 and 376 meters (Table 2).

2. Forest Cover

Forest cover is the area of primary vegetation (primary dryland forest, primary swamp forest, and primary mangrove forest) in the sample plots obtained from ArcGIS software. This forest cover affects the presence of Anoa related to the habitat that Anoa prefers. From the area measurement results, it is known that the smallest grid area (sample plot) of the research location (Anoa detected) is 88 hectares or 22.9% of the sample plot area. The widest is 400 hectares or 100% of the sample plot area. In the sample plots of the research location, no signs of Anoa (L3, I3, J1) were detected, namely 67.13 hectares (2.30%), 115.70 hectares (3.03%), and 0 hectares (no forest cover). Primary). More details can be seen in table 2.

3. Slope and Altitude

Slope is the angle formed by the slope's surface to the horizontal plane expressed as a percent (%). The altitude of a place is the height of a location above sea level. Altitude was measured directly in the field at the location of camera trapping and the location of finding traces of anoa animals using GPS (Global Positioning System). The measurement results show that the average altitude of the lowest and highest places at the study site, which detected signs of anoa presence and caught by camera traps, was 742 meters and 1.686 meters (Table 2). The average of the smallest and largest slopes at the study site, which detected signs of Anoa and were caught by camera traps, were 18% and 54% (Table 2).

Table 2. Measurement Results of Environmental Covariates that Affect Anoa Occupancy

Kovariat	Grid									
	G4	G5	G6	I4	I5	L3	I3	J1	J2	K3
Distance from road to animal trail finding (m)	2051	3195	4809	2526	3826	1137	0	0	3826	3814

Distance from cultivated area to animal tracks found (m)	1533	2676	4301	1608	2907	620	0	0	3783	3163
Distance from settlement to animal discovery (m)	2853	4026	5655	3713	4713	1892	1254	852	3826	4281
Distance from water source/river to animal trail finding (m)	126	166	376	291	290	348	50	2	374	42
Primary forest cover (ha)	275.22	392.82	400.00	376.81	400.00	67.13	115.70	0	88.00	352.97
Altitude Where Animal Footprints are Found (m dpl)	742	1029	1626	1100	1686	652	407	40	701	708
The slope of the place where animal tracks were found (%)	21	29.2	21.4	43.5	18	46	45	25	27	54

Anoa Habitat Occupancy

Anoa survey on 10 grids (G4, G5, G6, I4, I5, L3, I3, J1, J2, and K3) with 5 replications and a total of 46 replications, Anoa was found in 14 replications. Most often, Anoa was found in Grid G5 and G6 because it was found in 4 replications. In addition, the results of anoa occupancy analysis in the DakoMountain Nature Reserve from a direct survey (abandoned animal signs) can be seen:

1. Naive occupancy/naive occupancy in the form of a percentage of sample plots/locations detected anoa sign. For example, from 10 grids (sample plots), anoa marks were detected in 7 grids resulting in a naive occupancy of 0.7000 or 70% of the study area.
2. Psi (occupancy probability)/ occupancy rate of Anoa in the DakoMountain Nature Reserve is estimated at 0.85 or 85% (SE ± 0.1992). This data shows that Anoa inhabits about 85% of the entire research area of the Mount Dako Nature Reserve.
3. Anoa's detection probability value (p) is estimated at 0.3519 or 35.19% (SE ±0.0958) for each replication because there is no sampling covariate.

Replication in the survey using camera traps was the active day of camera trapping, so there were 90 replications in total. Out of 540 camera trap days, Anoa was detected on 17 days in 4 of 6 camera locations. Most often, Anoa was found in Grid I5 because it was found in 8 replications. The results of anoa occupancy analysis in the Mount Dako Nature Reserve from a survey with camera traps can be seen:

1. Naive occupancy/naive occupancy is the percentage of sample plots/locations that detected anoa signs. For example, 6 grids (sample plots) detected anoa marks in 4 grids resulting in a naive occupancy of 0.6667 or 66.67% of the study area.
2. Psi (occupancy probability)/occupancy rate of Anoa in the DakoMountain Nature Reserve is estimated at 0.6759 ± 0.1954 or 67.59% (SE ± 0.1954). This data shows that Anoa inhabits about 67.59% of the entire Dako Mountain Nature Reserveresearch area.
3. Anoa's detection probability value (p) was estimated at 0.0466 ± 0.0114 or 4.66% (SE ± 0.0114) for each replication because there was no sampling covariate.

The analysis shows that the occupancy rate of Anoa inhabits around 67.59% to 85% in the Dako Mountain Nature Reserve research area. The high occupancy rate of

Anoa in the DakoMountain Nature Reserve indicates that the anoa habitat in the DakoMountain Nature Reserve is still good for finding food, looking for water, sheltering, and breeding to maintain their lives. Habitat selection by Anoa is strongly influenced by the quality and availability of resources in it. Anoa habitat preferences are shown in locations far from human reach, namely in safe and undisturbed habitats. Preferences for non-forest habitat types are less preferred or tend to be avoided by Anoa (Arini& Nugroho, 2016). Anoa is a diffident animal and is very sensitive to various types of disturbances. These animals have a very sensitive sense of smell (olfactory system). Therefore, the slightest disturbance to their habitat will cause Anoa to avoid looking for a safer place (Mustari, 2020).

Occupancy or the area occupied by a species is an important variable for conservation. In the TanjungPeropa Wildlife Sanctuary and in the TanjungAmolengo Wildlife Refuge, the anoa habitat occupancy ranged from 0.62 to 2.26 anoa-day/km2. All types of habitat are used by Anoa both in the dry season and in the rainy season. This shows that these various types of habitats are important in the life of Anoa because each has a different abundance of resources (food, water and shelter) (Mustari, 2019).

The Effect of Environmental Covariates on Anoa Occupancy

There are seven environmental covariates that are thought to affect the occupancy and presence of Anoa, namely the distance from the road (Road), the distance from the cultivation area (Plantation), the distance from the settlement (Village), the presence of water sources (River), forest cover (Cover), altitude (Elevation) and slope (Slope). To determine the environmental covariates that have the most influence on anoa occupancy, in addition to using a model analysis of 1 environmental covariate/each environmental covariate, a combination of 3 or 4 environmental covariates that have an influence is also used, namely environmental covariates in the form of disturbances (Road+Plantation+Village) and environmental covariates. in the form of habitat conditions favored by Anoa (Cover+River+Elevation+Slope) and a combination of both (Cover+Road+Plantation). The results of the analysis of the occupancy model that show the role of environmental covariates on anoa occupancy in the DakoMountain Nature Reserve are as shown in table 3.

Table 3. Results of Occupancy Model Analysis Showing the Role of Environmental Covariates on Anoa Occupancy in DakoMountain Nature Reserve

	Model	AIC	ΔAIC	AIC wgt	ModelLikelihood	K	-2*LogLike
1	psi(Plantation),p(.)	56.02	0.00	0.3027	1.0000	3	50.02
2	psi(Road),p(.)	56.02	0.00	0.3027	1.0000	3	50.02
3	psi(Cover),p(.)	56.31	0.29	0.2618	0.8650	3	50.31
4	psi(.),p(.)	60.00	3.98	0.0414	0.1367	2	56.00
5	psi(Cover+Road+Plantation),p(.)	60.02	4.00	0.0410	0.1353	5	50.02
6	psi(Village),p(.)	62.53	6.51	0.0117	0.0386	3	56.53

	Model	AIC	ΔAIC	AIC wgt	ModelLikelihood	K	-2*LogLike
7	psi(River),p(.)	62.53	6.51	0.0117	0.0386	3	56.53
8	psi(Slope),p(.)	62.53	6.51	0.0117	0.0386	3	56.53
9	psi(Elevation),p(.)	62.53	6.51	0.0117	0.0386	3	56.53
10	psi(Cover+River+Plantation),p(.)	66.53	10.51	0.0016	0.0052	5	56.53
11	psi(Village+Road+Plantation),p(.)	66.53	10.51	0.0016	0.0052	5	56.53
12	psi(Cover+River+Elevation+Slope),p(.)	68.53	12.51	0.0006	0.0019	6	56.53

From the table above, it can be seen that the model by including the environmental covariates distance from the cultivation area (Plantation) and distance from the road (Road) is in the top order of psi (Plantation), p(.) and psi(Road), p(.) . This model ranks at the top with AIC value = 56.02. The smallest AIC value indicates that the model is the best model of all the models that are run with the support of 30.27% (AIC weight = 0.3027). This also shows that this model is the best model in explaining the anoa occupancy pattern in the DakoMountain Nature Reserve, TolitoliDistrict. The second and third best models, namely psi(Cover),p(.), and psi(.),p(.) have low support of 26.18% and 4.14%, respectively. The combination model by including more than one environmental covariate is at the top of the other combination models, namely psi(Cover+Road+Plantation), p(.) which has a very low support of 4.10%.

From the results of compiling data on the presence of Anoa both by direct surveys and surveys with camera traps and compiling data on measuring distance, height, slope or area of environmental covariates, the results of the analysis of anoa occupancy probability using environmental covariates can be seen in Table 4. it can be seen that the probability of anoa occupancy in the DakoMountain Nature Reserve is estimated at 71.29 (SE ± 0.12) to 80% (SE ± 0.00). While the probability of detection (p) of Anoa is estimated at 36.84% (SE ± 0.0783) to 40.51% (SE ± 0.0859) for each replication because there is no sampling covariate as shown in Table 5. The value of probability of detection (p) of Anoa more than 0.3 (30%) so that the anoa occupancy rate is classified as good. As according to Mackenzie et.al. (2005), that a good estimate for the occupancy value, if the detection probability> 0.3 (30%).

Table 4. Results of Anoa Occupancy Probability Analysis Using the Top-Order Environmental Covariates (Plantation, Road, Cover)

Individual Site estimates of <psi> Plantation and Road							Individual Site estimates of <psi> Cover			
	Site		estimate	S.E. 95%	conf. interval		estimate	S.E. 95%	conf. Interval	
Psi	1	G4 :	1	0	0 -	1	0.9935	0.0334	0.0059 -	1
Psi	2	G5 :	1	0	0 -	1	0.9971	0.0168	0.0032 -	1
Psi	3	G6 :	1	0	0 -	1	0.9971	0.0168	0.0032 -	1

Individual Site estimates of <psi> Plantation and Road									Individual Site estimates of <psi> Cover			
		Site		estimate	S.E. 95%	conf. interval			estimate	S.E. 95%	conf. Interval	
Psi	4	I4	:	1	0	0	-	1	0.9953	0.0255	0.0046	- 1
Psi	5	I5	:	1	0	0	-	1	0.9971	0.0168	0.0032	- 1
Psi	6	L3	:	1	0	0	-	1	0.3167	0.2781	0.036	- 0.8519
Psi	7	I3	:	0	0	0	-	1	0.4649	0.32	0.0653	- 0.9153
Psi	8	J1	:	0	0	0	-	1	0.0602	0.1382	0.0005	- 0.885
Psi	9	J2	:	1	0	0	-	1	0.3148	0.2776	0.0356	- 0.8513
Psi	10	K3	:	1	0	0	-	1	0.9922	0.0389	0.0068	- 1
		Rata-rata		0.8	0				0.7129	0.1162		

Table 5. Results of Anoa Detection Probability Analysis Using the Top-Order Environmental Covariates (Plantation, Road, Cover)

Individual Site estimates of <P[1]> Plantation and Road									Individual Site estimates of <P[1]> Cover			
		Site		estimate	S.E. 95%	conf. Interval			estimate	S.E. 95%	conf. Interval	
P[1]	1	G4	:	0.3684	0.0783	0.2318	-	0.53	0.4051	0.0859	0.2529	- 0.5779
P[2]	1	G4	:	0.3684	0.0783	0.2318	-	0.53	0.4051	0.0859	0.2529	- 0.5779
P[3]	1	G4	:	0.3684	0.0783	0.2318	-	0.53	0.4051	0.0859	0.2529	- 0.5779
P[4]	1	G4	:	0.3684	0.0783	0.2318	-	0.53	0.4051	0.0859	0.2529	- 0.5779
P[5]	1	G4	:	0.3684	0.0783	0.2318	-	0.53	0.4051	0.0859	0.2529	- 0.5779

Based on the estimated value of the Beta covariate coefficient (Beta's), the overall Beta coefficient is positive, indicating that the overall environmental covariate, both single and combined covariates, is positively correlated with anoa occupancy in the DakoMountain Nature Reserve. From the most influential covariates, namely the distance from the cultivated area and the distance from the road and primary forest cover, it can be seen that the positive correlation value is 2.24 with a standard error (SE) of ±0.652 and 2.66 with SE. ±0.631 and 0.86 with SE. ±0.788 as shown in Table 6. The positive correlation of the most influential covariates indicates that Anoa prefers areas far from cultivated areas and also far from roads and extensive primary forest cover. And vice versa, the chance of the area being inhabited by Anoa is low.

In Bogani Nani Wartabone National Park (TNBNW) the current preference for anoa habitat is shown in locations far from human reach, namely in safe and undisturbed habitats (Arini& Nugroho, 2016). Anoa is a shy animal and is very sensitive to various types of disturbances. These animals have a very sensitive sense of smell (olfactory system). Therefore, the slightest disturbance to their habitat will cause Anoa to avoid looking for a safer place (Mustari, 2020). In line with this study, the most influential environmental covariates inhabited by Anoa are habitats that are far from plantations (cultivated areas) and far from accessibility (roads). In the DakoMountain Nature Reserve, the closest distance to the study site (Anoa was detected) from the community cultivated area in the form of gardens (cloves, cocoa and other plantation crops) is 1,329 meters, while the farthest distance is 4,870 meters. The closest distance to the research location (detected Anoa) from the road is 2,051 meters, while the farthest distance is 5,388 meters.

Habitat selection by Anoa is strongly influenced by the quality and availability of resources in it. Primary forest vegetation is a good and preferred habitat for Anoa because it provides a place to find food, drink, shelter and breed. Primary forests include coastal forests, swamp forests, lowland forests, and mountain forests. In the DakoMountain Nature Reserve, the sample plots of the research site contain at least 22.9% to 100% primary forest vegetation of the sample plot area. Meanwhile, in the sample plots of the research location, there was no primary forest cover, nor were there any signs of Anoa detected.

The main threats to Anoa are poaching for consumption and habitat degradation to agriculture/plantation, mining (Burton et al. 2016). Attention to the preservation of Anoa's habitat and species needs to be increased. Mount Dako Nature Reserve has 3 (three) management blocks, namely Protection Block with an area of 18,493.15 Ha or 94.40% of the area of Mount Dako Nature Reserve, Rehabilitation Block with an area of 423.15 Ha or 2.16% and Special Block which has an area of 673.90 Ha or 3.44% (BKSDA Central Sulawesi, 2018). The protection block is an original ecosystem that is still maintained and is an anoa habitat that needs to be maintained in its integrity and sustainability from forest degradation or land conversion to maintain the mandate and management objectives of the DakoMountain CA area, namely maintaining habitat and increasing the anoa population (Bubalus spp).

Table 6. The Results of the Analysis of the Probability of Anoa Detection Using the Top Order Environmental Covariates (Plantation, Road, Cover)

	Model	A (ß-coefficient ± S.E.)	B *p*(ß-coefficient ± S.E.)
1	(Plantation),p(.)	2.242407 ± 0.651912	-0.538997 ± 0.336296
2	(Road),p(.)	2.660152 ± 0.631400	-0.538997 ± 0.336296
3	(Cover),p(.)	0.860581 ± 0.788114	-0.384461 ± 0.356540
4	(.),p(.)	1.734378 ± 1.562332	-0.610749 ± 0.420247
5	(Cover+Road+Plantation),p(.)		
	Cover;	5.525186 ± 10.000000	-0.538997 ± 0.336296
	Road;	2.550889 ± 10.000000	
	Plantation;	2.150301 ± 10.000000	

CONCLUSION

Anoa inhabits about 67.59% to 85% in the DakoMountain Nature Reserve, TolitoliDistrict. The best model in explaining anoa occupancy patterns in the DakoMountain Nature Reserve, TolitoliDistrict, is in the first to third order, namely the distance from the cultivated area, the distance from the road and the primary forest vegetation cover with the support of 30.27%, 30.27%, respectively and 26.18%. The three environmental covariates are positively correlated, indicating that Anoa prefers areas far from cultivated areas and also far from roads and extensive primary forest cover.

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