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Wildlife Monitoring Using Camera Trap at Gunung Celering Nature Reserve Jepara Regency Central Java

Budi Santoso[1], Muali[2], Danang Setyo Aji[3]
[1,2,3] Staff at Central Java Nature Resource and conservation Agency

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** E-mail*
budissi@yahoo.com

Abstrak

Telah dilakukan survey monitoring satwa liar di Cagar Alam Gunung Celering (CAGC) yang terletak di Kabupaten Jepara Jawa Tengah pada bulan September hingga November 2023 dengan menggunakan kamera jebak. Survey dilakukan untuk mengidentifikasi satwa liar, mengetahui pola aktifitas satwa liar dimaksud dan mengidentifikasi jenis-jenis satwa liar yang dilindungi di CAGC.

Hasil survey menunjukkan telah didapatkan 868 video dengan rincian 173 video satwa liar, 14 video aktivitas manusia dan 711 video non obyek. Video satwa liar berjumlah 173 terdiri dari 14 jenis satwa liar yang terdiri dari Aves 7 jenis (6 Ordo, 6 Famili), 5 jenis Mamalia (5 ordo, 5 famili), 1 jenis Reptil dan 1 jenis Amfibi. Dari 173 video satwa liar didapatkan 7 video dari 4 spesies yang beraktifitas pada malam hari. Selebihnya yaitu 166 video berhasil didokumentasikan pada siang hari. Satwa yang didokumentasikan pada malam hari yaitu Katak, Musang, Kucing hutan dan tikus. 14 jenis satwa liar yang ditemukan terdapat 3 jenis spesies dilindungi berdasar Permenlhk 106/2018, 2 jenis satwa dengan status En (endagered) dan 1 jenis satwa dengan status Vul (Vulnerable) berdasar IUCN serta 3 jenis satwa berkategori Apendiks II dan 1 jenis satwa masuk dalam kategori Apendiks I CITES.

Abstract

A wildlife monitoring survey was conducted in the Gunung Celering Nature Reserve (GCNR) located in Jepara Regency Central Java during September to November 2023 using camera traps. The survey was conducted to identify wildlife, determine the activity patterns of the wildlife in question and identify the types of wildlife protected in GCNR.

The survey results showed that 868 videos were obtained with details of 173 wildlife video captures, 14 videos of human activities and 711 non-object videos. The 173 wildlife videos consisted of 14 types of wildlife consisting of 7 Aves (6 Orders, 6 Families), 5 Mammals (5 orders, 5 families), 1 Reptil and 1 Amphibian. Of the 173 wildlife videos, 7 videos were obtained from 4 species that were active at night. The remaining 166 videos were successfully documented during the day. The animals documented at night were Frogs, Civets, Jungle Cats and Rats. Of the 14 of wild animals found, there are 3 protected species based on Permenlhk 106/2018, 2 types of animals with En (endangered) status and 1 type of animal with Vul (Vulnerable) status

based on IUCN as well as 3 types of animals with Appendix II category and 1 type of animal included in Appendix I CITES category.

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INTRODUCTION

Gunung Celering Nature Reserve (GCNR), located in Jepara Regency, is one of the important conservation areas in Central Java, Indonesia. The area with an area of 1,328 hectares is the largest area or 46.7% of all conservation areas under the management of the Central Java Natural Resources Conservation Agency(BKSDA Jateng, 2023). The area, which is part of the Muria peninsula landscape, is known for its abundant biodiversity. This area is also known for its role in preserving rare and endangered wildlife.

Towards the vision of GCNR management, careful management is needed. Therefore, in the management of GCNR, a deep understanding of the diversity of wildlife in it is needed. According to (Zwerts et al., 2021), the management of the Conservation Area is evidence-based, so that management decisions are based on valid data so that management becomes adaptive and sustainable. One effective method for monitoring wildlife diversity is to use camera traps. Camera traps are devices that are automatically installed in natural habitats and can detect and record wildlife activity without human interference (O'Connell et al., 2011). Penggunaan kamera jebak telah terbukti memberikan data yang akurat dan detail mengenai keberadaan serta perilaku satwa liar. Metode ini dapat membantu dalam analisis perubahan populasi dan distribusi spesies dari waktu ke waktu (Rovero & Zimmerman, 2010). Penggunaan kamera jebak dinilai efektif dan efisien terhadap keterbatasan sumberdaya baik finansial dan manusia. Kamera jebak dapat bekerja sepanjang waktu untuk memantau dan mendokumentasikan satwa liar dalam sebuah habitat yang sulit diakses (Trolliet et al., 2014).

The use of camera traps in nature reserves such as Celering Mountain has great potential to enrich information related to animal diversity, especially species that are difficult to detect using conventional methods. According to previous research, camera traps have been used successfully in various conservation studies in Indonesia, including in tropical forest areas and other nature reserves (Linkie et al., 2008); (Nugroho et al., 2013). The results of this study are expected to provide valuable information for nature reserve managers, researchers, and conservation institutions to plan more effective management and preservation strategies.

This study aims to monitor wildlife diversity in GCNR in Jepara Regency, Central Java using camera traps. The specific objectives of this study are as follows; (1) Identifying and documenting various wildlife species in the GCNR area. This includes mammals, birds, and other small animals that may be difficult to detect through conventional survey methods. (2) Understanding Wildlife Activity Patterns, in the form of daily activity patterns of detected wildlife, including active times, movement patterns, and interactions between species. This data can provide insight into wildlife adaptation to environmental conditions and factors that influence their behavior. (3) Identifying Rare and Threatened Species. This study is expected to record the presence of rare or endangered species in CAGC and evaluate potential threats that may affect their survival. (4) Providing the latest data for Management and Conservation. This study is expected to provide useful information for managers to design and implement more effective and data-based management and conservation strategies.

RESEARCH METHOD

Biodiversity monitoring activities through the use of camera traps use the method (1) collecting information including field orientation followed by camera installation. The installation of this camera was carried out starting on September 2, 2023 and harvested on November 16, 2023 or for 76 days. (2) Collection of literature related to wildlife and camera traps and (3) Field observations including identification of vegetation around the camera installation location.

The camera installation points in this study include 4 locations spread across GCNR. The location selection is based on the results of

information collection in the field where it is estimated that wild animals passing by will be easily found. The camera installation location can be seen in Figure 1. The camera is set to the date and recording mode. For the recording mode, video is used, which is then printed for analysis

purposes. The camera placement is arranged in such a way that it is possible to record wild animals passing by in the best position. The height of the camera to the ground or animal track in this study is between 40-50cm. After the position is correct, the camera is secured by installing a chain so that it is not easily stolen. At the time of camera installation, the position is recorded using GPS. Then observe the vegetation around the camera installation location.

Figure 1 Camera location map

The encounter rate (ER) is calculated based on the total number of photos of a particular animal obtained, then divided by the number of days the photos were installed and multiplied by 100. This value of 100 is a time calibration for adjusting the effort to calculate the encounter rate (O'Brien et al., 2003). Briefly, it can be described as follows;

$ER = \frac{\sum f}{\sum d}\ 100$ where;

ER = Wildlife encounter rate,
∑f = Number of wildlife photos obtained, and
∑d = Number of days of camera installation.

In addition to calculating encounters, the data obtained were also analyzed for diversity using the Shannon-Wiener diversity index (Odum, 1996) with the following formula:

$H' = -\sum Pi \ln (Pi)$ where $Pi = (ni/N)$

Where H' = Diversity index, Pi = Number of individuals of species i, and N = Total number of individuals of all species.

Meanwhile, the criteria for the Shannon-Wiener diversity index are:

H<1: Low diversity
1<H<3: Medium diversity, and
H>3: High diversity

RESULTS AND DISCUSSION

1. Species Identification and Documentation

Figure 2. A. Partridge (Galus sp) B. Black bittern (Dupetor flavicollis) C. Monitor lizard (Varanius salvator) D. Javan coucal (Centropus nigrorufus)

During this research period, the camera successfully identified and documented 868 videos with details of 173 wildlife video captures, 14 videos of human activities and 711 non-object videos. The 173 wildlife videos consisted of 14

types of wildlife consisting of 7 types of Aves (6 Orders, 6 Families), 5 types of mammals (5 orders, 5 families), 1 type of Reptile and 1 type of Amphibian (see table 1). The level of animal encounters showed that the highest were the Long-tailed Monkey (*Macaca fascicularis*) with a value of 125, the Javan Cheak (*Halcyon cyanoventris*) with a value of 23.68, the Squirrel (*Tupaia* sp) with a value of 19.74, the Turtledove (*Geopelia striata*) with a value of 17.11, the Javan Bubut (*Centropus nigrorufus*) with 11.84 and the smallest is the Monitor Lizard (*Varanus salvator*) with an encounter rate of 3.95 (see table 2 for more details). These identification results indicate high biodiversity in the CAGC area. This finding is consistent with findings from previous studies that showed the effectiveness of camera traps in documenting various species, including rare species(Linkie et al., 2008). Camera traps have proven to be an effective tool for wildlife surveys that are difficult to detect through direct encounter methods.

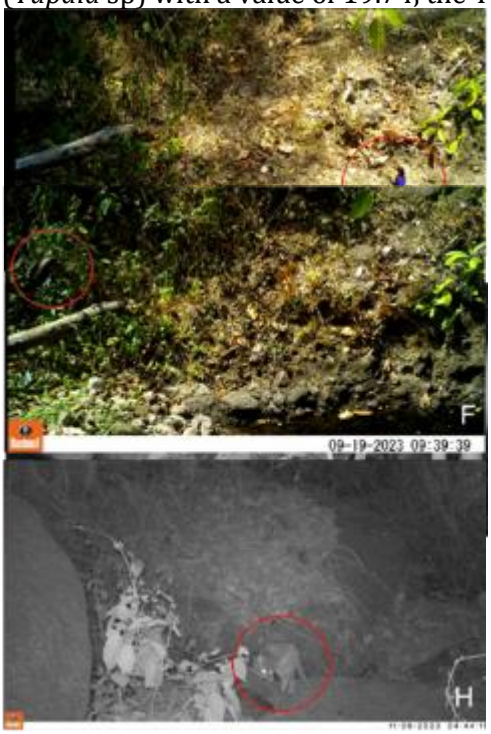


Figure 3. E Javan kingfisher (Halcyon cyanoventris) F. Asian pied starling (Sturnus contra) G. Frog (Rana sp.) H Leopard cat (Prionailurus bengalensis)

(Nugroho et al., 2013) stated that the use of camera traps can be used to monitor small mammals in tropical forests, including in Halimun Salak Mountain National Park. The results of the study showed that camera traps are effective in detecting various species of small mammals, such as civets and jungle cats, which are often missed by direct observation methods. Camera traps are able to provide data on the frequency of occurrence and activity patterns of these species, as well as documenting species that are rarely seen. (Tobler et al., 2008) compared the effectiveness of various camera trap models in the inventory of large mammals in Madidi National Park, Bolivia. The findings showed that camera traps can detect more species of large mammals, such as jaguars and tapirs, compared to conventional survey methods.

Table 1. Wildlife that were successfully caught on camera traps at GCNR

No.	Kelas	Ordo	Famili	Nama lokal	Nama species	Jumlah video
1	Aves	Galiformes	Phasianidae	Green peafowl	*Pavo muticus*	*8*
2		Galiformes	Phasianidae	Partridge	*Galus sp.*	*1*
3		Columbiformes	Columbidae	Turtledove	*Geopelia striata*	*13*
4		Coraaciiformes	Halcyonidae	Javan Kingfisher	*Halcyon cyanoventris*	*18*
5		Pelecaniformes	Ardeidae	Black bittern	*Dupetor flavicollis*	*3*
6		Cuculiformes	Cuculidae	Javan coucal	*Centropus nigrorufus*	*9*
7		Passeriformes	Sturnidae	Asian pied starling	*Sturnus contra*	*2*
8	Mamalia	Rodentia	Muridae	Mouse	*Rattus sp*	*1*
9		Scandentia	Tupaia	Squirrel	*Tupaia sp.*	*15*
10		Carnivora	Felidae	Leopard cat	*Prionailurus bengalensis*	*2*
11		Carnivora	Viveridae	Civet	*Paradoxurus hermaproditus*	*2*
12		Cercopithecoidae	Cercopithecidae	Long tailed macaque	*Macaca fascicularis*	*95*
13	Reptil	Squamata	Varanidae	Monitor lizard	*Varanus salvator*	*2*
14	Amfibi	Anura	Ranidae	Frog	*Rana sp.*	*1*

Figure 4. I. Long tailed macaque (Macaca fascicularis) J. Green peafowl (Pavo muticus) K. Civet (Paradoxurus hermaproditus) L. Turtle dove (Geopelia striata)

In addition, (Linkie et al., 2008) stated that the use of camera traps to monitor large mammals in tropical forests, especially in the Bukit Barisan Selatan National Park, Sumatra. Camera traps showed high ability in detecting large species that are difficult to observe directly, such as Sumatran tigers and Asian elephants. This study reported that camera traps can identify up to 15 species of large mammals, which were previously undetected by conventional survey methods. Camera traps are also effective in providing data on activity patterns and species distribution. (Rovero & Zimmerman, 2010) stated that the use of camera traps for wildlife monitoring in nature reserves showed that camera traps can detect the presence of up to 60 different species, including several rare and endemic species. Camera traps also provide valuable information on animal behavior patterns, such as daily and seasonal

Figure 5. M. Mouse (Rattus sp) N. Squirrel (Tupaia sp.)

movement patterns, and interactions between species. This study emphasizes the importance of camera traps in providing more complete and accurate data compared to traditional survey methods.

2. Wildlife diversity

Based on the wildlife photo data obtained, the diversity index value can be calculated. The Shannon Wiener diversity index for wildlife in GCNR shows a value of 1.48. This value indicates that the diversity is included in the moderate

Table 2. Wildlife encounter rates captured by camera traps at GCNR

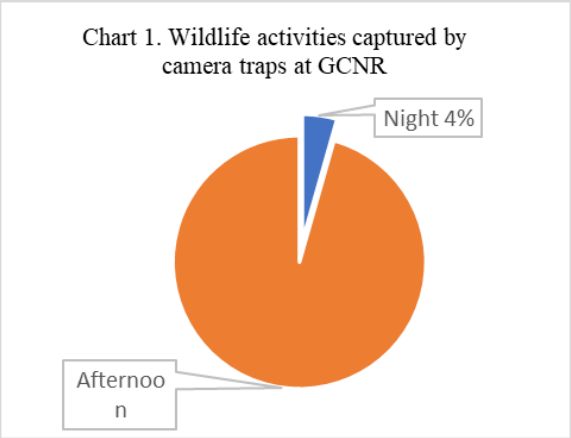
No.	Local Name	Scientific Name	ER
1	Long tailed macaque	*Macaca fascicularis*	125
2	Javan kingfisher	*Halcyon cyanoventris*	23,68
3	Squirrel	*Tupaia sp.*	19,74
4	Turtle dove	*Geopelia striata*	17,11
5	Javan coucal	*Centropus nigrorufus*	11,84
6	Green peafowl	*Pavo muticus*	10,53
7	Black bittern	*Dupetor flavicollis*	3,95
8	Monitor lizard	*Varanus salvator*	2,63
9	Asian pied starling	*Sturnus contra*	2,63
10	Leopard cat	*Prionailurus bengalensis*	2,63

11	Civet	*Paradoxurus hermaproditus*	2,63
12	Partridge	*Galus sp.*	1,32
13	Frog	*Rana sp.*	1,32
14	Mouse	*Rattus sp*	1,32

category. A moderate diversity index according to (Rynkiewicz et al., 2015) indicates that a wildlife community is in a healthy and stable condition because it is not vulnerable to external disturbances or environmental changes. Meanwhile, according to (Guo et al., 2017), the diversity value of an area can be used to develop priority planning for an area. This is in line with what was conveyed (Ahumada et al., 2011) that the resulting data can indicate the abundance and diversity of a species whose value can be used as a reference for area management.

3. Wildlife Activity Patterns

Data analysis shows the pattern of wildlife activity captured by camera traps shows that 7 videos or 4% of the videos were successfully



documented at night. The seven videos came from frogs (2 videos), civets (2 videos), cats (2 videos) and mice (1 video). The rest or 96%, namely 166 videos were captured by camera traps during the day. These animals are long-tailed monkeys (95 videos), green peafowl (8 videos), squirrels (15 videos), turtle doves (13 videos), starlings (2 videos), Javan kingfishers (18 videos), Javan coots. (9 videos), monitor lizards (2 videos), black storks (3 videos) and jungle fowl (1 video), (see diagram 1). This finding is in accordance with the results of research by (Nugroho et al., 2013), which shows that camera traps can provide detailed data on wildlife activity patterns, which are important for understanding species adaptation to their environment (Nugroho et al., 2013). This activity pattern data is useful for conservation planning that considers the time and behavior of species in protection efforts. According to (Mardiastuti, 2019) Animal behavior is influenced by changes in land cover which can ultimately lead to wildlife conflicts. Findings of human activity in the CAGC need to be watched out for. In addition to being suspected of causing changes in land cover, according to (Lewis et al., 2021) human activity can encourage increased nocturnal wildlife activity on routes where there is increased daily human activity.

(Mardiastuti, 2019) explains that animal activity patterns refer to the repetitive behavior and movements shown by animals in their natural habitat. Wild animals can adapt to changes in the situation and conditions of their habitat. However, (Herraiz et al., 2024) stated that the use of camera traps can help in estimating spatial patterns of habitat use with different levels of suitability depending on species and scale.

4. Ecosystem Health

From the data obtained, it can be seen that most of the habitats in CAGC support wildlife well. However, there are indications of threats of habitat destruction due to human activities. Human activities in CAGC can be suspected of

Table 3 . Conservation status of wildlife species caught on camera traps at GCNR

No.	Local Name	Scientific Name	P.106 Status	IUCN Status	Cites Status
1	Green peafowl	*Pavo muticus*	P	EN	II
2	Partridge	*Galus sp.*	NP	LC	
3	Turtle dove	*Geopelia striata*	NP	LC	
4	Javan kingfisher	*Halcyon cyanoventris*	NP	LC	
5	Black bittern	*Dupetor flavicollis*	NP	LC	
6	Javan coucal	*Centropus nigrorufus*	P	VU	
7	Asian pied starling	*Sturnus contra*	NP	LC	
8	Mouse	*Rattus sp*	NP		
9	Squirrel	*Tupaia sp.*	NP	LC	
10	Leopard cat	*Prionailurus bengalensis*	P	LC	I
11	Civet	*Paradoxurus hermaproditus*	NP	LC	
12	Long tailed macaque	*Macaca fascicularis*	NP	EN	II
13	Monitor lizard	*Varanus salvator*	NP	LC	II
14	frog	*Rana sp.*	NP		

having an impact on the decline in vegetation quality due to forest encroachment. These results support the findings in a study by (Rovero & Zimmerman, 2010), which stated that camera traps can help identify potential threats to habitat and threatened species. These findings indicate the need for more focused conservation actions to address threats to habitat and ensure ecosystem sustainability. The presence of wildlife captured by camera traps indicates that the ecological function of CAGC in supporting wildlife is running well. Healthy forest is a forest that supports ecological, social and cultural functions. According to (Ahumada et al., 2011) the presence of wild animals, especially land mammals, is key to tropical forest communities which can be used as an indicator of ecosystem health and as a provider of important ecosystem services.

These findings mainly include 3 types of protected species based on Permenlhk 106/2018, 2 specieses with endagered status and 1 species with vulnerable status based on IUCN as well as 3 specieses of animals in the Appendix II category and 1 species included in the CITES Appendix I category (see table 2). This research succeeded in identifying the existence of several rare and threatened species. These data underscore the importance of the GCNR as critical habitat for endangered species. These findings are in line with the study by (Tobler et al., 2008), who showed that camera traps are very effective in detecting rare and endangered species that are often difficult to monitor with other methods. That is in line with (Santoso & Restanto, 2021) that stated that the installation of camera traps in the Nusakambangan Timur Nature Reserve succeeded in documenting protected Javan leopards. Documentation of these rare species can be used to develop priority scales in CAGC

Tabel 4. Plant species found at camera trap observation stations at GCNR

No	Species			Station			
	Family	Local Name	Scientific Name	*1*	*2*	*3*	*4*
1	Anacardiaceae	Mangga	*Mangifera indica*	2		1	2
2	Apocynaceae	Pulai	*Alstonia scholaris*				1
3	Arecaceae	Palem gebang	*Corypha utan*	1			
4	Euphorbiaceae	Kemiri	*Aleurites moluccana*		2		
5	Fabaceae	Lamtoro	*Leucaena leucocephala*			4	
6	Fabaceae	Weru	*Albizia procera*	2	4	2	3
7	Fabaceae	Trembesi	*Samanea saman*			1	2
8	Flagelariaceae	Rotan wowo	*Flagellaria indica*	1		1	
9	Lamiaceae	Jati	*Tectona grandis*		3	4	6
10	Malvaceae	Randu	*Ceiba pentandra*	4	3	2	4
11	Meliaceae	Mindi	*Melia azedarach L*	2			1
12	Moraceae	Jrakah	*Ficus altissima*	1	3		
13	Moraceae	Beringin	*Ficus benjamina*		2	1	
14	Moraceae	Sukun	*Artocarpus altilis*				1
15	Moraceae	Nangka	*Artocarpus heterophyllus*	3	2		
16	Moraceae	Awar-awar	*Ficus septica*		2	1	2
17	Moraceae	Rampelas	*Ficus ampelas*				1
18	Moraceae	Bendo	*Artocarpus elasticus*	1	1		
19	Musaceae	Pisang	*Musa sp*				4
20	Myricaceae	Wuru	*Myrica javanica*				1
21	Myrtaceae	salam	*Syzigium polyanthum*		4		
22	Myrtaceae	Jambu klampok	*Syzygium densiflora*		1		
23	Phylanthaceae	Tampal besi	*Phyllanthus reticulatus*	1	1	1	
24	Salicaceae	Glingsem	*Homalium tomentosum*		1		
25	Sapindaceae	Kesambi	*Schleichera oleosa*	2			

5. Rare and Threatened Species

management planning. The urgent need for more intensive management and protection and management efforts can be determined accurately.

6. Effectiveness of Camera Traps

Camera traps have proven to be a very effective tool in monitoring wildlife diversity in GCNR. This method allows for the collection of accurate and detailed data on species presence and activity patterns without disturbing the natural habitat. Over a period of 76 days, camera traps were able to document wildlife and other activities passing through the observation area. These results are in line with the findings of (Eklund et al., 2014), which showed that camera traps are an efficient survey method and can be used to evaluate ecosystem health. This study strengthens the argument that this technology is a valuable tool for management and conservation. (Blount et al., 2021) stated that the use of camera traps is very effective for observing wildlife because of the long battery life and the ability to continuously record the presence of wildlife in nature.

7. Environmental tone

The environmental hue around the camera trap installation location is quite shady tending to be shady. The results of plant species identification show that there are 25 tree species from 16 families. Of the 16 families found the most in order are Moraceae (7 species), Fabaceae (3 species), Myrtaceae (2 species) and 1 species each, namely Anacardiaceae, Apocynaceae, Arecaceae, Euphobiaceae, Flagelariaceae, Malvaceae, Meliaceae, Myricaceae, Phylantaceae, Salicaceae and Sapindaceae (see table 4). The 25 plant species are Randu (*Ceiba pentandra*) and Weru (*Albizia procera*) found at all observation stations. Meanwhile, Mango (*Mangifera indica*), Teak (Tectona grandis) and Awar-awar (*Ficus septica*) were found at 3 of the 4 observation stations (see table 4).

Field observations show that some of these plants are bearing fruit, including Mango (Mangifera indica), Weru (*Albizia procera*), Randu (*Ceiba pentandra*), Beringin (*Ficus indica*) and Awar-awar (*Ficus septica*). The presence of these fruiting trees is the reason for the presence of wild animals coming around the camera trap location. This is in accordance with the opinion of (Safei et al., 2021) that the diversity of plant types in a forest will support the presence of wild animals in that habitat.

CONCLUSIONS

Throughout the observation, 868 videos have been obtained with details of 173 wildlife video captures, 14 human activity videos and 711 non-object videos. The 173 wildlife videos consist of 14 types of wildlife consisting of 7 Aves (6 Orders, 6 Families), 5 Mammals (5 orders, 7 families), 1 Reptile and 1 Amphibian. From 173 videos, 7 videos were obtained from 4 species that are active at night. The rest, or 166 videos, were successfully documented during the day. The wildlife that documented at night are Frogs, Civets, Jungle Cats and Rats. There are 3 protected species based on Regulation of the Minister of Forestry and Environment No. 106/2018, 2 species with endangered status and 1 species with vulnerable status based on IUCN as well as 3 species with Appendix II category and 1 species included in Appendix I on CITES category.

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