

**FAUNA DIVERSITY IN THE SOUTHERN PART OF THE KON KA KINH
NATIONAL PARK, GIA LAI PROVINCE**

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ABSTRACT

Kon Ka Kinh National Park (KKK NP) is a priority zone for biodiversity protection in Vietnam as well as ASEAN. In order to survey the current fauna species diversity in the southern part of the KKK NP, we conducted camera trapping surveys in 2017, 2018, and 2019. 28 infrared camera traps were set up on elevations between 1041 to 1497 meters. In total, there were 360 days of survey using camera trap. As result, we recorded a total of 27 animal species of those, five species are listed in the IUCN Red List of Threatened Species (IUCN, 2020). The survey results showed a high richness of wildlife in the southern park region, and it also revealed human disturbance to wildlife in the park. The first-time camera trap was used for surveying wildlife diversity in the southern region of the KKK NP. Conducting camera trap surveys in the whole KKK NP is essential for monitoring and identifying priority areas for wildlife conservation in the national park.

Keywords: Camera trapping, conservation priority, fauna diversity, habitat, Kon Ka Kinh National Park.

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INTRODUCTION

Kon Ka Kinh was declared a nature reserve by the Government of Vietnam in 1999. In 2002, KKK was upgraded to national park status, covering an area of 41,780 hectares (Frankfurt Zoological Society, 2014). KKK NP is known as a global priority area for biodiversity conservation. KKK NP is located 12 km west of Kon Chu Rang Nature Reserve (KCR NR). The Kon Ka Kinh - Kon Chu Rang Landscape (KKK-KCR Landscape) supports over 100,000 ha of natural forest occurring from 500 m to 1,748 m, including a large proportion of the forested catchments of the Ba River and Con River. The intervening forest area between KKK and KCR remains under the management of Dakrong and Tram Lap State Forest Companies (SFCs). Linking KKK NP and KCR NR will create a landscape for large mammal population conservation. In addition, a number of rare and endangered species was recorded in KKK NP, such as Truong Son Muntjac (*Muntiacus truongsonensis*) endemic species to Indochina, Northern yellow-cheeked crested gibbon (*Nomascus annamensis*), Grey-shanked douc langur (*Pygathrix cinerea*), Stump-tailed macaque (*Macaca arctoides*) (Frankfurt Zoological Society, 2014), Asian black bear (*Ursus thibetanus*), Himalayan porcupine (*Hystrix brachyuran*) (Le Trong Trai et al., 2000). KKK NP is home to one of the biggest population of the grey-shanked douc langurs (Frankfurt Zoological Society, 2014).

1022 species of higher vascular plants were recorded from 568 genera and 158 families at KKK NP. Fauna includes 470 species with 42 mammal species, 166 bird species, 29 reptiles species, 22 frog species, 6 fish species and 205 butterfly species. Of those, 47 species of wild animals are listed in the Vietnam Red Data Book (2007), 12 species are globally threatened (IUCN, 1996). 16 species are endemic to Vietnam. 5 rare bird species and 3 mammal species endemic to Indochina were also identified (Frankfurt Zoological Society, 2014).

KKK NP is located in the Kon Tum Endemic Bird Area (EBA) (Le Trong Trai et al., 2000). The chestnut-eared laughing thrush (*Ianthocincla konkakinhensis*) is an endemic bird and listed on the IUCN (2020). This rare bird was discovered in KKK NP in 1999 (Eames, 2001) and became a “symbol” for KKK NP. KKK NP is currently recognized as one of 63 important bird areas in Vietnam (Tordoff, 2002).

The observed rapid decline in biodiversity, particularly among large vertebrates, throughout the world and the degradation of natural habitats are nowadays widely accepted as fact (Barrows et al., 2005). Wildlife in KKK NP is also facing many threats from illegal poaching and habitat disturbance. So, it is essential to understand how animal populations respond to modern threats and to document the functioning of ecosystems and intra-community interactions.

Unfortunately, there is no research yet to regularly update data on animal populations, especially wide-ranging species that occur at naturally low densities. In order to collect data, provide evidence and update species composition in the national park, we conducted surveys on fauna diversity by using the camera traps.

This is the first time camera traps were installed to provide data on the current status of species composition in the southern part of the KKK NP that has not been fully studied. The research results support future research on key biodiversity areas of the national park.

METHODOLOGY

Location and description of study sites

The study area chosen was located in the southern part of the KKK NP (14°13'N - 108°20'E). Vegetation types include primary forests or evergreen forests occurring at an average elevation from 900 m to 1,400 m and mixed coniferous and

broadleaf forest containing *Fokienia hodginsii* (1,300–1,400 m).

The weather in KKK NP has 2 separate seasons. The rainy season lasts from May to November, the dry season starts in December and lasts to April. The average annual temperature ranges from 21 °C to 25 °C. The highest average temperature is 25 °C in May. The lowest average temperature was at 16 °C in January; especially in the Kon Ka Kinh

peak area, the temperature is dropping below 15 °C. The total average annual rainfall varies from 2,000 mm to 2,500 mm. The rainfall is concentrated from May to November, accounting for 70–75% of the whole year's rainfall. The average annual humidity is 80%. The main wind direction in the dry season is the southwest monsoon wind and the northeast monsoon blows in the rainy season months.

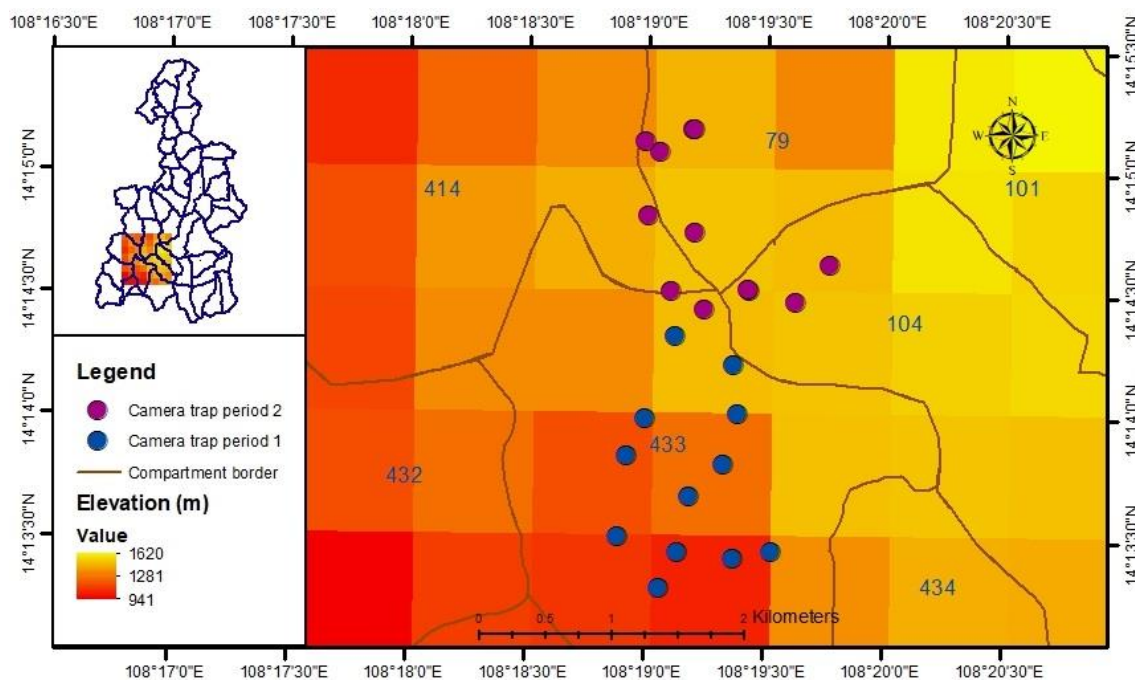


Figure 1. Study area and camera trap sites

Field survey method

The camera traps were setup in sub-zone 433, 104, 79, 414 in the southern area of the KKK NP from December 2017 to June 2019. These areas were randomly selected. The camera traps were kept at 500 meters distance between each device.

The research team included one researcher (camera trap technician), two rangers and one local guide who had more experience in wildlife surveys. The devices were set up based on species' ecology and

the observation of wildlife signals such as footprints, animal food, digging in the ground, or scratches on tree trunks, scents, animal trails, holes and animal burrows. In addition, habitat type, anthropological disturbance, and fragmentation level were assessed to select the camera position. Priority areas were selected and marked on the map based on the interview results and combined with the forest status map. Accordingly, primary forest areas were prioritized target areas.

Camera trapping surveys

We conducted two periods of surveying for 6 months (from December 2017 to February 2018 and March 2019 to June 2019). 28 camera traps (Bushnell Trophy Cam 8.0 Mp) were set up. This camera has active infrared sensors (AIR sensors) that operate by emitting a single infrared beam from an emitter to a receiver. When an animal disrupts the beam, by preventing the beam from reaching the receiver, the camera is triggered and takes an image.

Camera location: Cameras were placed in locations that optimise the detection of all the target species. This means locations, where the species are most likely to be encountered and detected. The cameras must have brackets for stabilization against strong wind. Rain, wind and vegetation such as falling leaves interrupting the beam (detection range) do cause many false triggers (Jackson et al., 2005; Brown &

Gehrt, 2009). So, it's necessary to cut off small branches, fallen tree branches in front of the camera. The space in front of the cameras was usually 3–4 m in width × 6–10 m long. Each device was set up along a 2 km long distance with at least 500 m space between each camera trap.

Camera installation: Each device has a SD memory card with 16 GB that can hold up to 16,000 images and 4 AA Energizer batteries with operating time from 2–3 months when installed at Interval = 2 s and Continuously 3 images /1 shot. The Image size is 8 M (Pixel). Our memory card and device pin are checked periodically 2 times/year.

We used a digital elevation model (DEM) to create the camera traps elevation map to determine species distribution according to altitude. The research area topography was clipped from the DEM Model based on the Clip Raster tool in ArcGIS and calculated an average elevation camera trap (Fig. 1).

Table 1. The camera trap setting up data in the southern Kon Ka Kinh National Park

Period	The number of camera traps	Camera trap days	Elevation (m)
12/2017–2/2018	16	180 days	1,041–1,497
3/2019–6/2019	12	180 days	1,461–1,497
Total camera traps: 28		Total camera trap days: 360 days	

Data analysis

To identify species, we carefully checked all images and videos from the camera traps memory card. In some cases, we used Adobe Photoshop CC 2020 to enhance the image quality for species identification. In addition, we uploaded image data to an online database for species classification (<http://cameradata.ioz.ac.cn/>). All species images were also checked again by experts in species classification (birds and mammals).

RESULTS AND DISCUSSION

Species richness results

We recorded a total of 27 species of animals belonging to 8 orders and 17 families in the southern area of the KKK NP.

The results of the survey on species diversity are shown in Table 2. The results show that the number of animals belonging to the civet family (Viverridae and Mustelidae) was quite abundant in the southern region. Ferret-badger (*Melogale* sp.) and Masked palm civet (*Paguma larvata*) have the highest recorded frequency.

5 species comprising Stump-tailed macaque (*Macaca arctoides*), Northern pig-tailed macaque (*Macaca leonine*), Asian small-clawed otter (*Aonyx cinerea*), Mainland serow (*Capricornis sumatraensis*) and Chestnut-eared laughingthrush (*Garrulax konka kinhensis*) were listed as vulnerable (VU) in the IUCN World Red List (2020).

Table 2. List of animals recorded by camera trap in the southern area of Kon Ka Kinh National Park

No.	Species		2017–2018	2019	Conservation status	
	English name	Scientific name	Camera traps recorded	Camera traps recorded	Vietnam Red Data Book (2007)	IUCN Red List of Threatened Species (2020)
A	Carnivores	Carnivora				
A1	Civets	Viverridae				
1	Masked palm civet	<i>Paguma larvata</i> (C.E.H. Smith, 1827)	CT06, CT10, CT07, CT13, CT16, CT19, CT12	CT10, CT01, CT07		LR
A2	Linsangs	Prionodontidae				
2	Spotted linsang	<i>Prionodon pardicolor</i> (Hodgson, 1841)	CT05	CT08	VU	LR
A3	Cat	Felidae				
3	Leopard cat	<i>Prionailurus bengalensis</i> (Kerr, 1792)		CT16, CT10		LC
A4	Weasels, martens and otters	Mustelidae				
4	Ferret badger	<i>Melogale</i> sp.	CT02, CT10, CT08, CT11, CT15, CT07, CT06, CT12	CT18, CT06, CT03, CT15, CT08, CT10, CT02		LR
5	Yellow-throated marten	<i>Martes flavigula</i> (Boddaert, 1785)	CT03, CT06, CT12			LC

6	Asian small-clawed otter	<i>Aonyx cinerea</i> (Illiger, 1815)		CT15	VU	VU
A5	Mongoose	Herpestidae				
7	Crab-eating mongoose	<i>Urva urva</i> (Hodgson, 1836)	CT09, CT19, CT07	CT18, CT15, CT08		LC
B	Rodents	Rodentia				
B1	Squirrel	Sciuridae				
8	Black giant squirrel	<i>Ratufa bicolor</i> (Sparrman, 1778)	CT05, CT10	CT16, CT01	VU	NE
9	Asiatic striped squirrels	<i>Tamiops sp.</i>	CT07, CT12			
B2	Murids	Muridae				
10	Long tail giant rat	<i>Leopoldamys sp</i>	CT05, CT10, CT19			LC
C	Primates	Primates				
C1	Macaque	Cercopithecidae				
11	Stump-tailed macaque	<i>Macaca arctoides</i> (I.Geoffroy, 1831)	CT02, CT04, CT07, CT08, CT09, CT10, CT16, CT19, CT11, CT12	CT18, CT06, CT03, CT16, CT08, CT01, CT02	VU	VU
12	Northern pig- tailed macaque	<i>Macaca leonina</i> (Blyth, 1863)	CT06, CT16, CT05, CT15, CT11		VU	VU
D	Even-toed ungulates	Artiodactyla				
D1	Cattle, antilopes etc	Bovidae				

13	Mainland serow	<i>Capricornis sumatraensis</i> (Bechstein, 1799)	CT12		EN	VU
E	Galliformes, gallinaceous	Galliformes				
E1	Francolins, Quails and Pheasants	Phasianidae				
14	Silver pheasant	<i>Lophura nycthemera</i> (Linnaeus, 1758)	CT16, CT19, CT07	CT03, CT16, CT10	LR	LC
15	Bar-backed partridge	<i>Arborophila brunneopectus</i> (Blyth, 1855)	CT11			
16	Green-legged partridge	<i>Tropicoperdix chloropus</i> (Blyth, 1859)		CT16		LC
F	Passerine	Passeriformes				
F1	Lauchingthrushes	Timaliidae				
17	Chestnut-eared laughingthrush	<i>Garrulax konkakhensis</i> J.C. Eames&eames 2001	CT03, CT15	CT08, CT11	VU	VU
18	Red-tailed laughingthrush	<i>Trochalopteron milnei</i> (David, 1874)		CT18, CT16		LC
19	Black-hooded laughingthrush	<i>Garrulax milleti</i> (Robinson & Kloss, 1919)	CT15, CT07	CT16, CT10, CT02		NT
F2	Pittas	Pittidae				
20	Blue-winged pitta	<i>Pitta moluccensis</i> (Statius Müller, 1776)	CT10	CT06, CT10		LC

21	Rusty-naped pitta	<i>Hydromis oatesi</i> (Hume, 1873)		CT16		LC
F3	Flycatchers	Musciapidae				
22	White-crowned forktail	<i>Enicurus leschenaulti</i> (Vieillot, 1818)		CT15		LC
F4	Dusting	Cettiidae				
23	Grey-bellied tesia	<i>Tesia cyaniventer</i> (Hodgson, 1837)		CT15		LC
F5	Thrush	Turdidae				
24	Orange-headed thrush	<i>Geokichla citrine</i> (Latham, 1790)	CT16, CT07			LC
G	Owl	Strigiformes				
G1	Barn Owls	Tytinidae				
25	Barn owl	<i>Tyto alba</i> (Scopoli, 1769)		CT15		LC
H	Pigeons	Columbiformes				
H1	Pigeons and Doves	Columbidae				
26	Emerald dove	<i>Chalcophaps indica</i> (Linnaeus, 1758)		CT11, CT02		LC
27	Green imperial pigeon	<i>Ducula aenea</i> (Linnaeus, 1766)		CT15		LC

Note: CT1 - CT19: Name of camera traps, EN: Endangered, VU: Vulnerable, LC: Least Concern, NE: Not Evaluated, NT: Near Threatened.

The IUCN red list of threatened species 2020 in the southern area of Kon Ka Kinh National Park

Stump-tailed macaque (Macaca arctoides) and Pig-tailed macaque (Macaca leonine)

The camera trap images showed that stump-tailed macaque (*M. arctoides*) occurred at 20 camera locations and the Northern pig-tailed macaque (*M. leonine*) occurred at 6 locations. These monkey species were recorded at an average elevation between 1,044 m to 1,491 m in the evergreen forests in

the southern region of the KKK NP. Based on the distance between different camera traps that captured these species, there is no direct competition for habitat.

The two species distribution was in the southern region (in this research) and the northern area of the KKK NP according to Le Trong Trai et al. (2000). The frequent presence of these two monkeys in the area are good indicator for general ecosystem health and are thus helpful in conservation planning.



Figure. 2. Camera trap image of threatened primates: a) Stump-tailed macaque (*Macaca arctoides*); b) The pig-tailed macaque (*Macaca leonine*) in the southern area of the KKK NP [Image: FZS]



Figure 3. Camera trap image of Asian small-clawed otter (*Aonyx cinerea*) in the southern region of the KKK NP [Image: FZS]

Asian small-clawed otter (Aonyx cinerea)

The topography of the southern area has many small streams which is a favourable habitat for otters. We set up the camera traps along the streams towards Kon Phe waterfall. The Asian small-clawed otter was captured at 6:00 am at coordinates 14013'N - 108019'E when the otter was looking for food in the small stream area. A total of 3 individuals was recorded in this survey. This is also the first time this species was recorded by camera traps in the southern part of the KKK NP.

Mainland serow (Capricornis sumatraensis)

Based on the previous research of the mainland serow presence in KKK NP (Kon Ka Kinh National Park, 2012; Frankfurt Zoological Society, 2014) and the ungulates footprints in the survey area, the camera trap CT12 was set up at coordinates 14014'N - 108019'E. A total of 47 mainland serow images were taken at night in the species habitat. These images show one individual of mainland serow. Some images were recorded in 2-day repeats, so this area may have been the species refuge. The images showed the mainland serow behaviour through nighttime grooming, scratching at tree trunks, and guarding behaviour to avoid predators around the living area.



Figure 4. Camera trap image of mainland serow (*Capricornis sumatraensis*) in the southern of KKK NP [Image: FZS]

Chestnut-eared laughingthrush (Garrulax konkakinhensis)

Chestnut-eared laughingthrush (*Garrulax konkakinhensis*) is a Vietnam endemic species.

According to Birdlife International (2000), the Chestnut-eared laughingthrush was only recorded in the northern area of

the KKK NP. However, in this survey, there was a total of 4 camera traps CT03, CT15, CT08, CT11, that captured this species at an average elevation between 1177 to 1497 meters. Evergreen forests and mixed coniferous and broadleaf forests were the characteristics of the species habitat distribution.



Figure 5. Camera trap image of Chestnut-eared Laughingthrush (*Garrulax konkakinhensis*) in the southern area of KKK NP [Image: FZS]

Threats to wildlife in the southern region of the Kon Ka Kinh National Park

Some illegal activities such as hunting, logging, expanding farming areas and harvesting of non-wood forest products (NTFPs) are the main threats to all wildlife species in KKK NP (Ha Thang Long, 2009).

In this study, we identified that hunting, NTFP collection and the use of motorbikes in the national park were three main threats to wildlife in the southern region of the KKK NP. Some camera traps often recorded local people going to the forest to hunt and collect NTFPs.

Through the camera traps data, 6 people were identified carrying knives and large bags of NTFPs. Some cameras were discovered and deliberately destroyed. Although some camera traps were set up in the non-trail area, the number of local people recorded in the forest was high. In

order to avoid detection by park rangers, the hunters and NTFP collectors avoided the forest trails. In one area frequented by local people, the camera traps data recorded very few species of animals. Local communities living in the buffer zone in the southern area of the national park regularly go to the forest to collect NTFPs and other products for their livelihoods.

Although park rangers have blocked motorbikes in the core zone of the KKK NP, the noisy vehicles still run through the forest. This created a great disturbance to the wildlife habitat in the southern area of KKK NP.

This research did not record any medium or large-sized carnivores. Hunting, trapping and habitat loss are leading to the serious decline of wild carnivores in Vietnam as well in KKK NP. Most of the national parks and protected areas in Vietnam also rarely record large-sized carnivores.



Figure 6. Local people went to the forest to harvest NTFPs

Conservation efforts

In order to conserve the natural forest and biodiversity of the park, the Frankfurt Zoological Society has cooperated with the Kon Ka Kinh National Park in enhancing the effectiveness of wildlife law enforcement in the last 10 years. Through capacity building for the park rangers, the SMART program on forest patrol was trained and applied. Park rangers remove about 200 to 450 traps per year. Park rangers also conducted wildlife monitoring activity in the core zone area. The data on the occurrence area of threatened species in the park was used to plan a forest patrol trip more effective. In terms of law enforcement to protect wildlife in the park, the evidence from camera traps helped to arrest and prosecute the individuals who were caught in the act of setting snares and/or possessing snares in the forest.

Until now, the SMART program has been applied for at least four (4) forest stations of the park. We highly recommend this program should be applied to the whole park. The database on disturbance from human activities in the southern of KKK NP should be updated to improve the effectiveness of the law enforcement.

In addition, regularly organize communication programs to increase communities awareness on wildlife conservation and the law of wildlife protection. Mobilize local people to surrender their illegally-stored guns and sign a commitment on hunting, trapping and firearm prohibitions.

CONCLUSION

28 camera traps were setup for 360 days in the field. 27 wildlife animals were identified and recorded in the elevation ranging from 1041 to 1492 meters. Of those 5 species were listed as vulnerable (VU) in the IUCN Red List (2020). This was also the first time that camera trapping was used in wildlife diversity research in the southern area of the KKK NP. The results recorded a number of species that had not been discovered before in this area. The civet family (Viverridae) and the weasel's family (Mustelidae) were abundant in the southern region.

The survey results showed the species richness, especially the distribution of endangered and precious species prioritized for conservation. However, the southern region of the KKK NP is still facing threats such as hunting and habitat disturbance by

local people. Therefore, it is essential to enhance forest patrolling, remove traps and law enforcement to stop illegal activities.

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