

Gaur recovery and management in Khao Phang Ma Non-Hunting Area, northeastern Thailand

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Keywords: Human and Wildlife Conflict, Gaur, Khao Phang Ma Non Hunting Area

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ABSTRACT

The long-term conservation of wildlife and habitats in Thailand, by the establishment of protected areas together with active protection and management, has resulted in the clear recovery of various wildlife species. Gaur (*Bos gaurus*) is a threatened wild cattle species that experienced severe population declines due to poaching and habitat destruction. It is also a species that has shown a positive response to the conservation measures in different protected areas in Thailand. In some protected areas, the recovery along forest edges has led to conflicts with farmers growing crops that are attractive to gaur.

Human-wildlife conflict has become a global concern in and around protected areas. Khao Phang Ma Non-Hunting Area (KPM) in northeastern Thailand is an area facing the problem of crop-raiding by gaur. Here, an electric fence has been used to prevent gaur leaving the protected area and raiding crops. The objectives of this study were to investigate the density and distribution of gaur, to compare the density of gaur found inside and outside the electric fence, and to compare the index of abundance and area usage of gaur in areas under different management types. Moreover, this study concerned the opinions of local people around KPM about conflict management. Therefore, the methodologies were to (1) study the density and distribution of gaur in KPM by distance sampling, (2) count dung and tracks of gaur in different land use types in KPM, and (3) interview local people with a pre-designed set of questions.

The study found a mean abundance of 253 individual gaurs along KPM's forest edge, and gaur were more likely to be found inside of the electric fence than outside. The survey found a higher gaur abundance inside than outside the electric fence. This study also showed that gaurs used the restored and natural areas more than agriculture areas. Furthermore, the local people agree with the present conflict management. Thus, these results indicated that increasing the food supply inside KMP and setting up the electric fence has helped reduce conflicts.

Keywords: Human-wildlife conflict, Gaur, Khao Phang Ma Non-Hunting Area

INTRODUCTION

Gaur (*Bos gaurus*) is the largest extant bovine and is native to Southeast Asia. The International Union for Conservation of Nature (IUCN) has listed gaur as Vulnerable (Duckworth et al. 2016). Under Thailand's Wildlife Law it is classified a protected species, under the Wildlife Reservation and Protection Act B.E. 1992 (Ratchakitchanubeksa, 1992). A countrywide survey conducted by the Government of Thailand reported the distribution status of gaur in 13 forest complexes. It reported that only 7% of Thailand's land area is supporting viable populations of gaur with high and medium abundance of tracks and signs (Wildlife Research Division, 2010). In some protected areas, gaur recovery has occurred along the forest edges next to farmlands and has created conflicts between gaur and local communities.

Recovery of wildlife in protected areas surrounded by farmland can lead to human-wildlife conflict, especially when wildlife forages on farmland outside protected areas. This type of conflict has been increasing globally due to the expansion of agricultural lands (Madden, 2004; José et al., 2010). This issue becomes more serious if a species is threatened and has a large home range (Michalski et al., 2006). Furthermore, human-wildlife conflicts also negatively influence broader economic and political aspects of biodiversity conservation (Treves, 2007). Farmlands near forest edges have higher risks of crop damage from wildlife than the ones further away (Rao et al. 2002, Kiffner et al. 2012). Farmers in conflict with wildlife sometimes resort to killing or poisoning the animals. In Thailand, a well-known case of gaur recovery caused conflict with villagers along the border of a protected area; Khao Phaeng Ma Non-Hunting Area (KPM). In this study, we aimed to estimate the population of gaur along the edge of KPM and to document the management options that the Government of Thailand has used to handle the situation.

METHODS

Study area

KPM is an 8 km² area of restored montane forest, contiguous to the north-eastern boundary of Khao Yai National Park in north-eastern Thailand (Figure 1). Originally, the area was forest which was cleared for farming and degraded by fires. However, in 1994 a local conservation group named Wildlife Fund Thailand received a permission from the Royal Forest Department to launch a reforestation project on the 800 ha area of KPM by working with local communities. After some period of restoration, with no poaching, gaur from Khao Yai started to show up in the KPM land in small groups of 4-10 individuals. In 2005, the area was established as a non-hunting area with staff from the Department of National Parks, Wildlife and Plant Conservation looking after the area. The KPM staff estimated the gaur population size from direct counts and reported more than 200 individuals using KPM (Jinda 2015, personnel communication). In 2016, Laichanthuek et.al (2017) estimated the

total gaur population around KPM to be 271 individuals.

The surrounding areas of KPM have been largely cleared for cassava and corn. Such types of crop attract gaur to come out and feed on them. In order to resolve a human-gaur conflict, KPM tried various methods including putting up an electric fence, improving the habitat by planting more grasses inside the non-hunting area, and building barriers such as ponds.

In this research, we focused on human-gaur conflict management based on two main techniques - the electric fence and habitat improvement. Thus, the objectives of this study were 1) to determine the density and distribution of gaur in KPM, 2) to compare the density of gaur between inside and outside the electric fence, and 3) to compare the index of gaur abundance in the areas with different management activities.

Field survey

1.1 Roadside count and distance sampling for gaur density estimate in KPM

Following Stainbrook (2011), we used an existing 14 km road along the border of KPM as a line transect. We surveyed gaur by driving slowly along the road looking for gaur with a spotlight between 1900 and 2100 hrs. When we spotted a gaur we recorded 1) GPS location, 2) number of individuals, 3) sex, 4) age class, and 5) perpendicular distance of the gaur from the road's main direction. We repeated the road survey for gaur 16 times from September 2014 to March 2015.

1.2 Index counts of gaur habitat use under different management schemes

To compare gaur habitat use among three areas, we modified the method used by Goswami et al. (2004). We selected three grid squares of 1 km², each with a different management history including 1) farmland with corn and cassava outside KPM, 2) restoration area with ponds and grasses, and 3) the original forest area with no restoration (Figure 2).

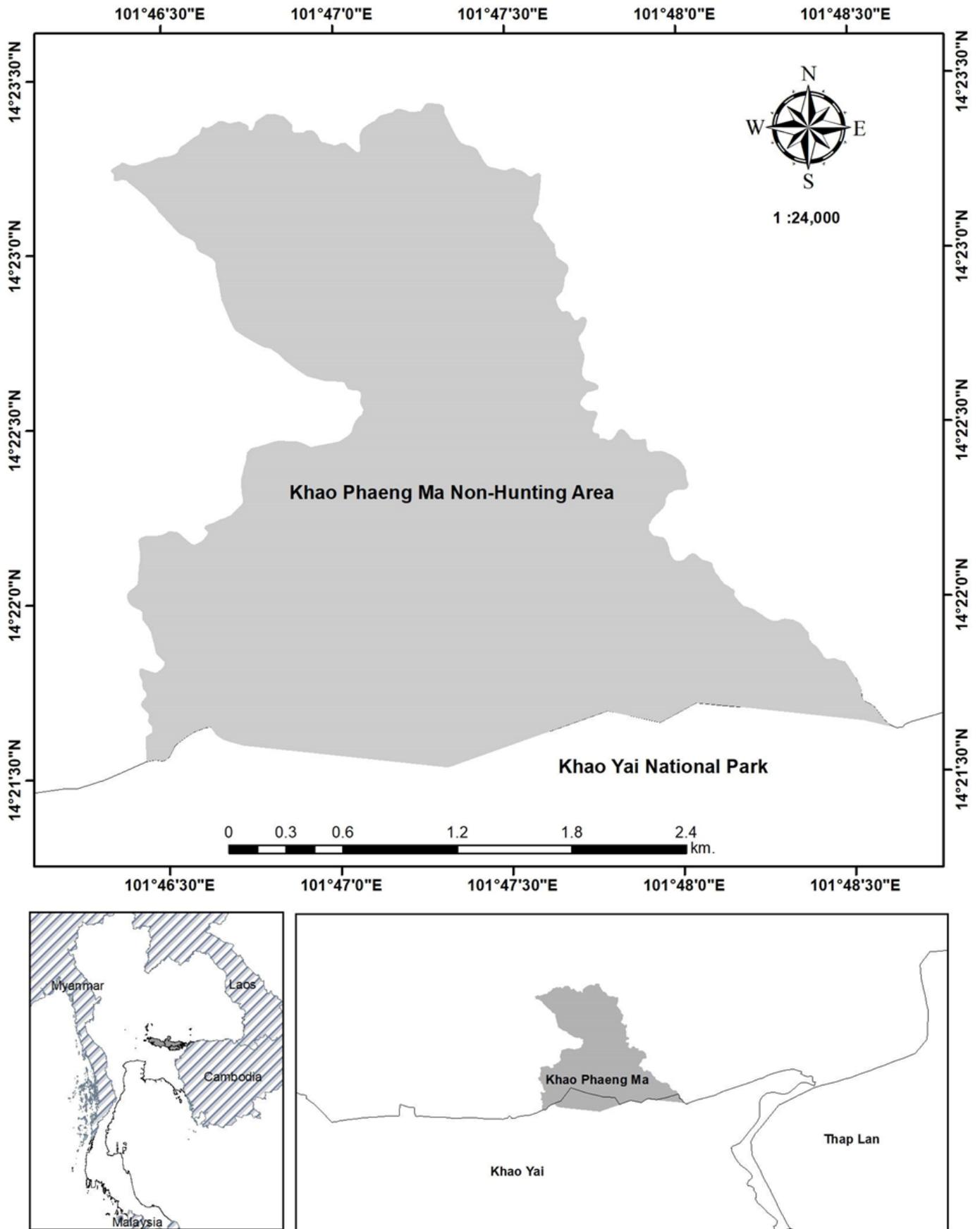


Figure 1 Khao Paeng Ma Non-Hunting Area (KPM), one of the protected areas in Dong Phrayayen-Khao Yai forest complex.

In each grid cell, we surveyed by walking past nine randomly predetermined points (Figure 3) looking for gaur dung falling within a 4 m strip from the center of the walking trail (Dawson & Dekker 1992, Dekker et al. 1991). The distance

walked per grid cell was about 3 km per survey. We divided the data along this 3 km into 100 m segments (Figure 4). After we recorded a dung pile, we removed it to prevent repeated counts in the next survey.

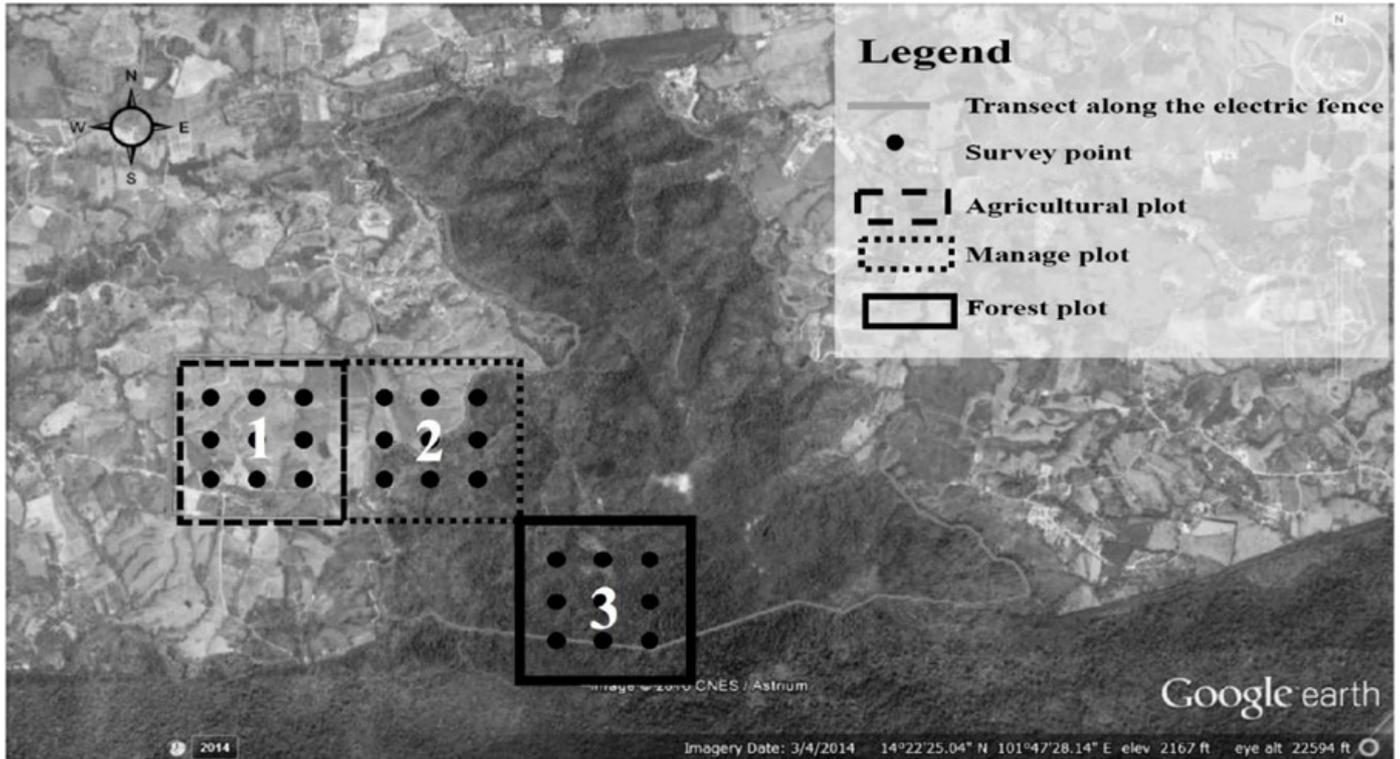


Figure 2 Nine survey points within each of three 1 km² sampling plots for gaur habitat use in KPM. Modified from Google Earth, 2014.

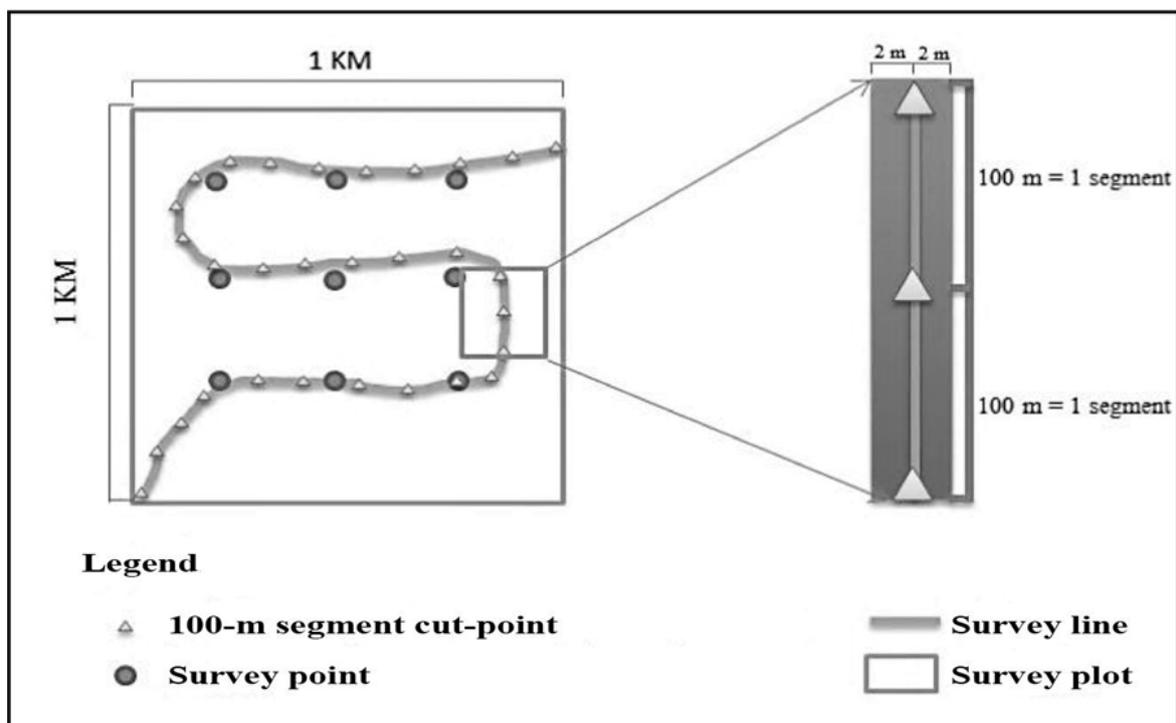


Figure 3 The survey line for gaur dung observation in each 1 km² plot.

Data Analysis

1.1 Population density

We used ArcGIS 10.1 to define gaur position by direct observation and to define a 1 km buffer along the electric fence that covered assumed habitat use of gaurs in KPM. We calculated the density of gaur every 1 km and used it as an index of habitat use along the edge of KPM. The density of guar was calculated following Buckland et al. (2004) using the following equation in DISTACE 5.1:

$$D = \frac{nf(0)}{2L}$$

D = Density of gaur

n = number of gaur

f(0) = a probability density function at distance x=0

L = Length of survey line

A t-test was used to determine whether there was a significant difference in density and habitat use of gaur between the areas inside and outside of the electric fence.

1.2 Abundance of gaur dung and habitat use of gaur in difference management areas

To compare amounts of dung (a proxy for habitat use of gaur) in each difference management areas we used an Analysis of Variance (ANOVA).

RESULTS AND DISCUSSION

1.1 The density of gaur in KPM

In our study we found 253 gaurs along KPM’s forest edge using the road site count. Based on comparisons of AIC val-

ues the hazard rate proved to be the best fit for our dataset. The estimates by the DISTANCE analyses are presented in Table 1 showing the estimated density of cluster size was 4.08, and the density of animals was 11.89 per km².

The distance from the line with the highest detection probability was 20 m (Figure 4). Our result was similar to that of the KPM data that reported 250 gaurs from direct count surveys at night. This suggests that the population size of gaur has been increasing in KPM since a previous study was conducted by Bidayabha (2001), which reported the number of gaurs was 18 - 20 individuals in 2001, 96 individuals in 2006 and 160 individuals in 2011 until the non-hunting area was established. Furthermore, this is consistent with Laichanthuek et.al. (2017), who estimated the gaur population to be 271 individuals in 2016 and density to be 2.44 per km² (based on the 111.15 km² total area used by the animal).

The result showed that gaurs’ most-used habitats were where the buffer zone connected to agricultural areas and open terrain (Figure 5). In addition, the roadside count survey at night did not disturb gaur activity in the same way that the research of Morelle et al. (2012), who studied roe deer (*Capreolus capreolus*) and wild boar (*Sus scrofa*) using roadside counts, did.

The study found the number of gaur along KPM’s forest edge was 312 inside and 26 outside of the fence by roadside count. The T-test used to compare the two showed that the mean abundance of gaurs inside of the fence was significantly higher than the number of gaur outside (t = 4.65; P-value = 0.002) (Table 2).

Table 1. The population density, cluster size, and number of individual gaur per unit area. Estimated using DISTANCE Software.

Parameter	Point Estimate	SE	%CV	95% CL
Density of cluster size	4.08	0.7	17.18	2.89 - 5.74
Density of gaur per km ²	11.89	2.47	20.81	7.90 - 17.88
Estimate of population	253	52.63	20.81	168.00 - 381.00

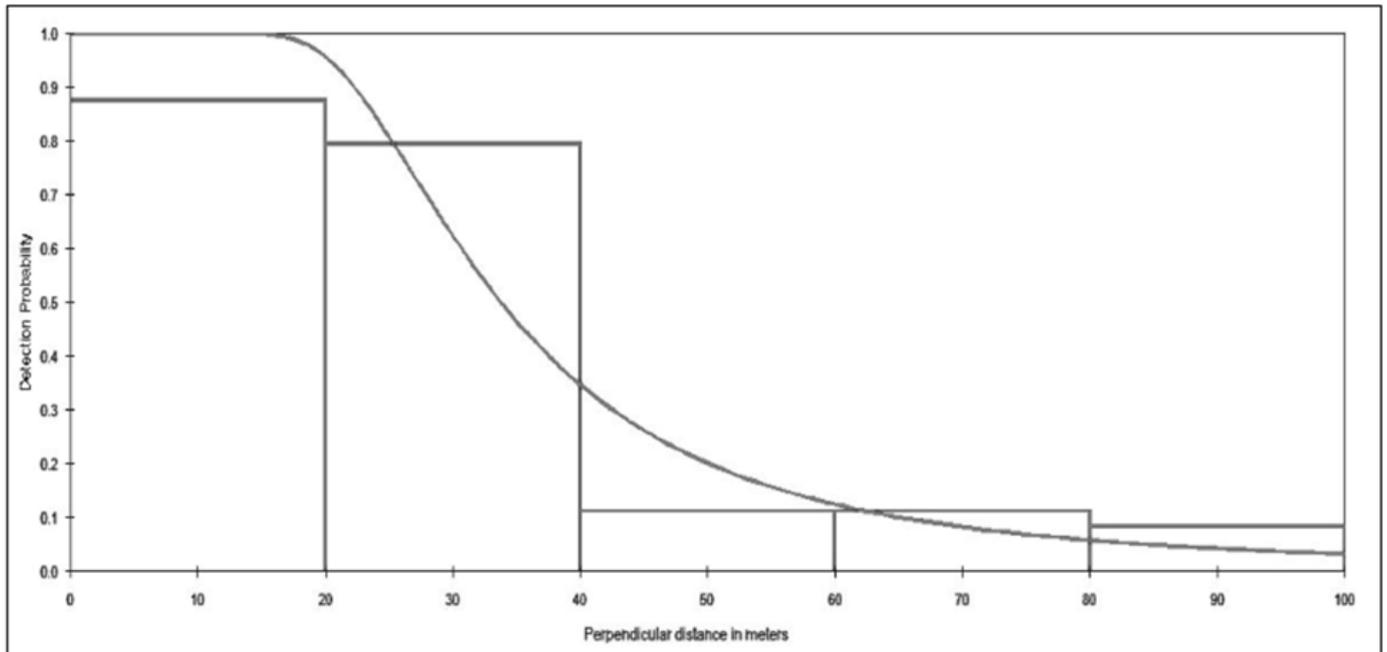
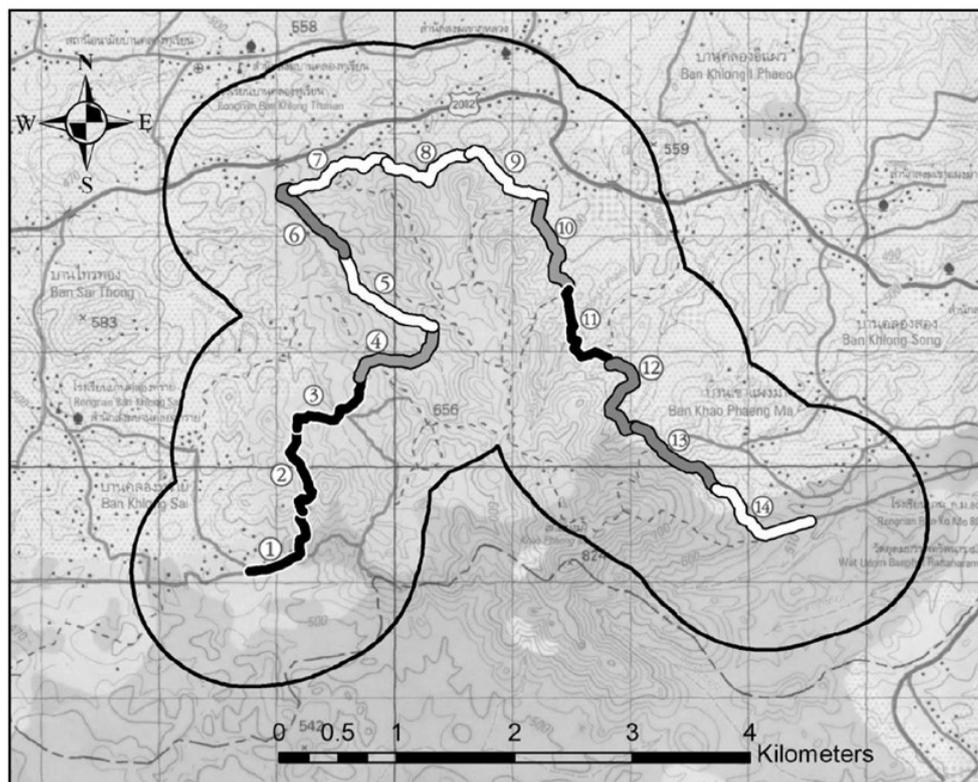


Figure 4 Probability of detection of gaur on both sides of the road in KMP, as a function of distance the middle road



Legend

- Gaur sighting
- ▭ Buffer zone (within 1 km from the road)
- ▬ Transect with high probability of gaur detection (> 2.1 gaurs/survey)
- ▬ Transect with mediu, probability of gaur detection (0.6-2 gaurs/survey)
- ▭ Transect with low probability of gaur detection (0-0.5 gaurs/survey)

Figure 5 The survey line for gaur dung observation in KPM using 1 km² plots.

Table 2. The result from a t-test for differences between means of the number of gaur inside and outside an electric fence in KPM

variable	n	\bar{x}	SD	t	df	P-value
The number of gaur found inside of the fence	312	19.5	14.57	4.65	17.69	0.002
The number of gaur found outside of the fence	29	1.81	4.38			

Table 3. The results of the ANOVA test for differences between means of gaur using the restoration area, natural areas and agriculture area in and around KPM.

variable	n	\bar{x}	SD	F	P-value
Agriculture area	1	0.167	0.41		
Restoration areas	142	23.67	8.98	5.2	0.03
Natural areas	90	15	10.88		

This supports the effectiveness of the electric fence in preventing the gaur from entering farmland.

1.2 Habitat use of gaur under different management schemes

The dung count result showed that gaur used the restoration areas the most and agriculture areas the least (natural land being the intermediate). Using an ANOVA to make a comparison of the means of the dung count index for habitat use, we found that the difference was significant among the three different management areas (F=5.20, P-value=0.03) (Table 3).

The gaur's preferred area of use, inside KPM rather than agriculture areas, may be so because there is a greater supply of water and food, and prescribed burning to enhance forage availability. This conforms to findings of Prayong (2014), which revealed that effective habitat management can improve habitat suitability for gaur. Furthermore, Bhumpakphan (2006) reported that gaur habitat suitability in protected areas was greatest where there is natural forest that included trees and undergrowth. In addition, our

result corresponds to those of Ambica & Mathur (2012) whose study of gaur habitat found that the most suitable habitat was characterised by a crown cover of more than 30%, open grassland and mixed deciduous forest and open grassland. Prayong & Srikosamatara (2017) demonstrated that improving habitat, by cutting down trees (such as *Macaranga siamensis*) that overshadowed gaur's food patches, had a positive impact on attempts to encourage the growth of gaur populations.

Current management

Besides the habitat improvement as mentioned previously, KPM has tried to improve the conflict management of gaur in different ways. KPM, together with a local conservation network, has setup electric fences along the boundary of the area to prevent gaur from coming out and raiding crops. Unfortunately, there are around 2 km of gaps without electric fence. Furthermore, when the batteries are low and the electric current is weak, some gaur have learned to penetrate the fences to raid crops. Therefore, more fencing and better maintenance is needed for the electric fences to be more effective.

Another important intervention is to promote the area for wildlife tourism, especially gaur viewing. The records of tourists visiting KPM since 2016 show almost 20,000 people visiting KPM with 2019 is the record year of almost 25,000 people. This tourism activity has generated local incomes for the communities nearby.

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