# Recolonization of Former Range by Endangered Banteng Bos javanicus in Mae Wong National Park, Thailand

Authors: Phoonjampa, Rungnapa, Steinmetz, Robert, Phumanee, Worrapan, Bunchornratana, Komsan, Kaewsrisod, Teerawut, et al.

Source: Tropical Conservation Science, 14(1)

Published By: SAGE Publishing

URL: https://doi.org/10.1177/19400829211065359

Tropical Conservation Science
Volume 14: 1–6

DOI: 10.1177/19400829211065359
journals.sagepub.com/home/trc
SAGE

# Recolonization of Former Range by Endangered Banteng *Bos javanicus* in Mae Wong National Park, Thailand

**Rungnapa Phoonjampa[1], Robert Steinmetz[1], Worrapan Phumanee[1], Komsan Bunchornratana[1], Teerawut Kaewsrisod[1], Surasak Srirattanaporn, Kitiphat Taraphibarl[2], Thawatchai Bejraburnin[2], and Naris Bhumpakphan[3]**

## Abstract

Many large ungulate species, including the banteng (*Bos javanicus*), are on the verge of extinction. Mae Wong National Park in Thailand was once a haven for banteng due to its abundance of preferred habitat, but the species was extirpated in the 1970s due to logging and hunting, before park designation. Mae Wong is connected with Huai Kha Khaeng Wildlife Sanctuary (HKK), which retains the largest banteng population remaining in Thailand. In 2019, Mae Wong park rangers reported suspected banteng footprints near HKK. We used camera traps to verify the presence of banteng and determine their population structure and activity pattern. We observed at least nine individual bantengs (range 1–7 each month) during the 15-month survey, including three adult males, two adult females, three juveniles, and 1 calf. Solitary males and herds (up to five animals) were observed, reflecting typical social structure. Banteng were detected throughout the survey and across all seasons, suggesting a resident population. Our research confirms the return of banteng to Mae Wong after an absence of over 40 years. The banteng likely dispersed from HKK, emphasizing the importance of landscape connectivity and source sites for recovery of endangered species. Though still small, the Mae Wong population is breeding, which is significant for future population recovery. Protection, community outreach, and habitat management can help secure this population. As banteng is the preferred food of tigers, their recovery will benefit tiger conservation in Mae Wong as well.

## Keywords

camera trap survey, connectivity, dispersal, large ungulates, population recovery, threatened species

## Introduction

Many large herbivorous mammals are near extinction as a result of hunting and habitat loss (Ripple et al., 2015). The banteng (*Bos javanicus*) is an endangered bovid with a declining global population of less than 8000 mature individuals; remaining banteng populations are in Cambodia, Indonesia, Malaysia, Myanmar, Vietnam, and Thailand (Gardner et al., 2016).

The population of bantengs in Thailand was about 2300–2500 individuals in 1970; 25 years later, the number had plummeted by more than 80% to roughly 500 (Srikosamatara & Suteethorn, 1995). Huai Kha Khaeng Wildlife Sanctuary (HKK) in the Western Forest Complex holds about 300 bantengs, the largest population remaining in Thailand (Prayurasiddhi, 1997; Srikosamatara & Suteethorn, 1995).

Mae Wong National Park lies north of HKK and is contiguous with the forests of HKK. Mae Wong was once home to a substantial population of bantengs due to its expansive lowland deciduous forest, which is the preferred habitat of banteng (Lekagul & McNeely, 1977; Prayurasiddhi, 1997).

[1]WWF-Thailand, Bangkok, Thailand
[2]Department of National Parks, Wildlife and Plant Conservation, Bangkok, Thailand
[3]Faculty of Forestry, Kasetsart University, Bangkok, Thailand

Received: 13 September 2021; accepted: 22 November 2021

Long before it became a national park, Mae Wong forest was a well-known hunting ground for banteng. Banteng hunting in the Mae Wong forest was documented in 1908 (Figure 1), where the animals were shot by visiting sportsmen of the era (Gairdner, 1917). Later, the Mae Wong forest was opened to commercial logging and roads were built to access timber. Logging was concentrated in the lowland deciduous forests which was the main habitat of banteng. Logging operations were accompanied by commercialized hunting, and banteng were among the targeted species. As a result, bantengs were extirpated from Mae Wong in the 1970s (pers. comm. Mae Wong park rangers), before National Park designation in 1987. In this article, we document the return of banteng to Mae Wong National Park.

**Figure 1.** Male banteng hunted in Mae Wong forest in 1908 (Gairdner, 1917).

## Methods

### *Study Site*

The study was conducted at Mae Wong National Park (894 km$^2$), in western Thailand (99°4′27″ E to 99°21′59″ E, 15°39′52″N to 16°06′60″ N). Habitats include mixed deciduous forest, dry dipterocarp forest, secondary forest with bamboo, and semi-evergreen forest. Elevation ranges from

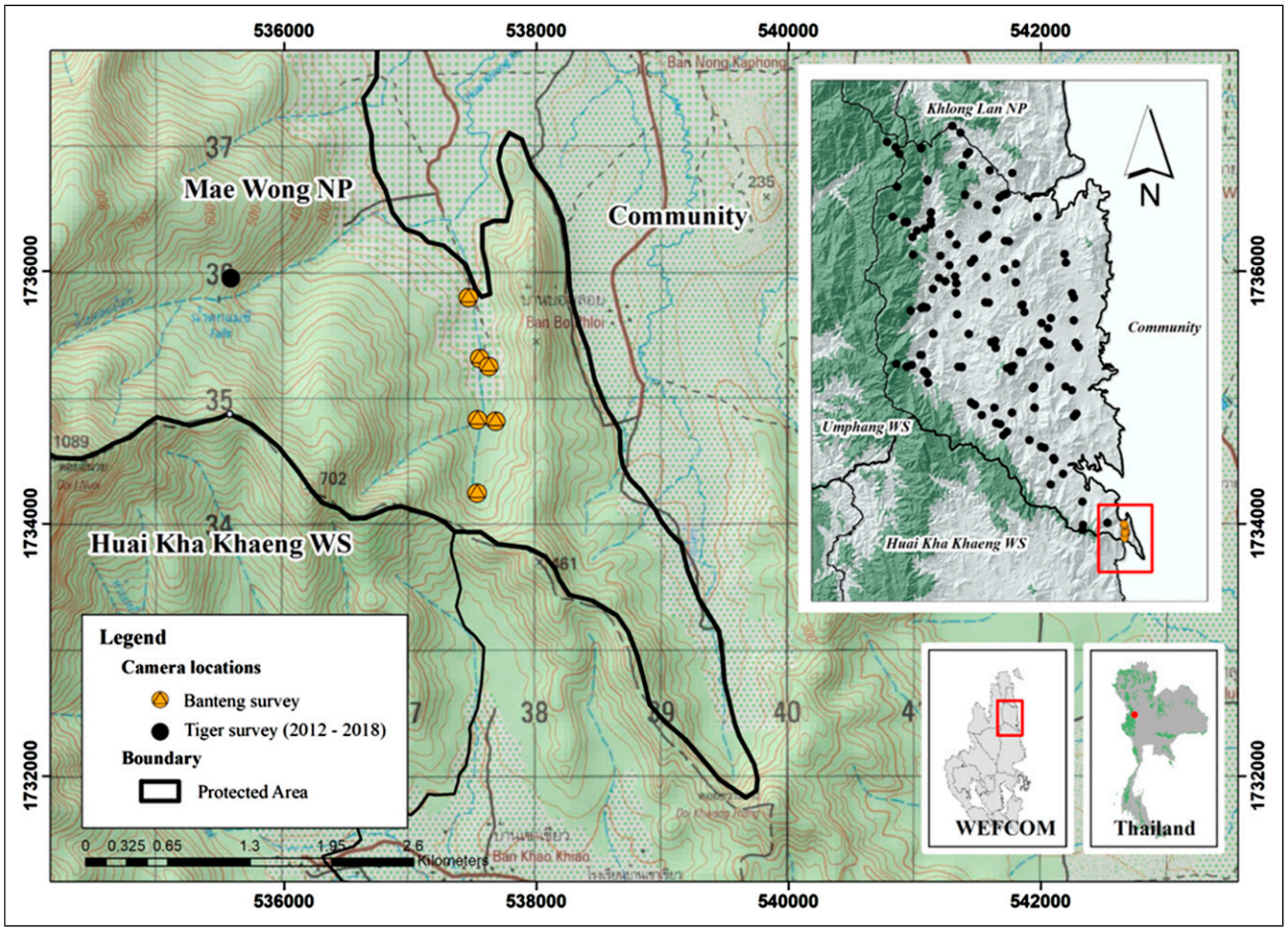


**Figure 2.** Camera trap locations of the banteng survey (yellow triangles) in the southeast corner of Mae Wong National Park, 2019–2020. The inset map shows the locations of a park-wide camera trap survey for tigers and large mammals (black dots) during 2012–2018.

**Table 1.** Minimum number of individual bantengs observed, and camera trap effort in Mae Wong National Park, February 2019–April 2020. Counts were based on multiple photos and videos of banteng from various angles as the animals moved around in front of cameras.

| Month, Year | Season | Ad. Male | Ad. Female | Juvenile | Calf | Sum | Trap Nights | Independent Photos | Photo Encounter Rate |
|---|---|---|---|---|---|---|---|---|---|
| Feb 2019 | Dry | 0 | 0 | 0 | 0 | 0 | 24 | 0 | 0.00 |
| Mar 2019 | Dry | 0 | 1 | 1 | 0 | 2 | 93 | 2 | 2.15 |
| Apr 2019 | Dry | 2 | 0 | 0 | 0 | 2 | 90 | 3 | 3.33 |
| May 2019 | Rainy | 2 | 0 | 0 | 0 | 2 | 93 | 2 | 2.15 |
| Jun 2019 | Rainy | 0 | 0 | 0 | 0 | 0 | 90 | 0 | 0.00 |
| Jul 2019 | Rainy | 2 | 2 | 0 | 0 | 4 | 93 | 7 | 7.53 |
| Aug 2019 | Rainy | 0 | 0 | 0 | 0 | 0 | 111 | 0 | 0.00 |
| Sep 2019 | Rainy | 0 | 2 | 0 | 1 | 3 | 150 | 1 | 0.67 |
| Oct 2019 | Rainy | 2 | 2 | 1 | 0 | 5 | 138 | 1 | 0.72 |
| Nov 2019 | Dry | 2 | 2 | 3 | 0 | 7 | 118 | 16 | 13.56 |
| Dec 2019 | Dry | 0 | 0 | 0 | 0 | 0 | 76 | 0 | 0.00 |
| Jan 2020 | Dry | 0 | 0 | 0 | 0 | 0 | 113 | 0 | 0.00 |
| Feb 2020 | Dry | 0 | 1 | 0 | 0 | 1 | 60 | 1 | 1.67 |
| Mar 2020 | Dry | 1 | 0 | 1 | 0 | 2 | 60 | 2 | 3.33 |
| Apr 2020 | Dry | 1 | 2 | 0 | 0 | 3 | 29 | 6 | 20.69 |

Photo encounter rates were calculated as [(numbers of independent photos)/(numbers of trap nights) x 100]. Independent photos were photos separated by > 30 minutes.

150 to 1964 m above sea level. The area has a dry season (November–May) and a wet season (May–October). Average annual rainfall is 1300 mm and the mean temperature is 28°C.

### *Camera Trap Survey*

Mae Wong park rangers reported suspected banteng footprints in February 2019, in the southeast corner of the park, near HKK. To verify the existence of banteng, we established six camera trap sites in the area, which seemed sufficient to cover the thin valley where banteng signs were concentrated (Figure 2); 3–5 of these sites were operational in each month. Infrared camera traps (Bushnell Trophy Cam HD, Moultrie White Flash, Scoutguard White Flash) were placed along animal trails, old roads, at mineral licks, and at locations with abundant banteng tracks and dung. Elevations of camera locations ranged from 223 to 310 m above sea level. Cameras were attached to trees 50 cm above the ground (Channa & Gray, 2010) and operated 24 hours. Cameras were programmed to take consecutive 15-second videos, each video preceded by one photo. Cameras were checked once a month. The survey was conducted between February 2019 and April 2020.

In addition to this dedicated banteng survey, we conducted widespread camera trapping across Mae Wong National Park, as part of a tiger monitoring project (Figure 2). In this larger project, cameras were spaced every 2–4 km across the entire park, at 186–1564 m elevation. Camera trapping was conducted in 2012, 2014, 2016, and 2018, with 44–52 camera sites established each year (Figure 2, inset). We summarize the results of these surveys in terms of banteng observations. This extensive, long-term survey of the wider park establishes a spatial and historical context for the dedicated banteng survey, which focused on a tiny portion of the park where banteng signs were found in 2019.

We classified each banteng as adult male (> 3 years old), adult female (> 3 years), juvenile (1–3 years), or calf (< 1 year), based on the shape and size of horns, and on body size and shape. We learned how to distinguish sex and age classes of banteng by observing a captive herd with individuals of known sex and age, at Salakpra Wildlife Sanctuary (Kanchanaburi, Thailand). Our camera trap videos frequently captured groups of banteng moving together, allowing us to distinguish and count different individuals, even within the same sex-age class. Some banteng also had unique marks, allowing individual recognition. For example, one adult male had three dark patches on his left flank, and an adult female had unique black marks on her horns. Based on these features, we tallied the minimum number of banteng observed in each sex and age class in each month, yielding a rough estimate of population structure and numbers of individuals.

We used the time-stamped photos and videos to assess banteng activity patterns. We calculated a kernel density function using the "overlap" package in R (Ridout & Linkie, 2009). This produces a probability density curve of detections at different times of the day.

## Results

The banteng survey accumulated 1338 trap nights (range: 24–150 trap nights per month) of effort (Table 1). We obtained 51 photographs and 61 videos of bantengs. Bantengs were captured in all six locations, in both dry and rainy seasons


**Figure 3.** Banteng in Mae Wong National Park, 2019. (A) Adult male, (B) two adult females, and calf.

(Table 1). We observed banteng in 10 of 15 months of sampling (Table 1); the 5 months in which no banteng were captured were interspersed between months with captures, suggesting banteng were present but undetected. The minimum number of banteng observed each month ranged from 1 to 7 (Table 1). Both solitary individuals and herds were observed. The largest herds were of five animals, and included adult males, adult females, and juveniles moving together. One calf < 1 month old was photographed walking with its mother (September 2019; Figure 3); assuming a 10-month gestation, mating would have occurred in October 2018. At least nine different individuals were observed during the 15-month study, including three adult males, two adult females, three juveniles, and 1 calf. Banteng were mostly nocturnal (83% of encounters between 1800–0600), with a spike of activity from dusk to early evening (1800–2100) (Figure 4).

The park-wide tiger surveys accumulated 18,800 camera trap nights over 7 years (2012–2018), but banteng were never detected. All other ungulate species expected to occur were detected, including gaur (*Bos gaurus*), sambar (*Rusa unicolor*), wild pig (*Sus scrofa*), and muntjacs (*Muntiacus vaginalis*, *M. feae*) (Phumanee et al., 2020).

## Discussion

Our study documents the first confirmed presence of banteng in Mae Wong National Park for at least 40 years, and represents the first natural recolonization by banteng into previous range that we are aware of in Thailand. Banteng have been reintroduced, from captivity, into two other reserves in Thailand (Chaichanathong et al., 2021). Banteng have disappeared from most of mainland Southeast Asia due to habitat loss, habitat fragmentation, and trophy hunting for horns (Gardner et al., 2016; Srikosamatara & Suteethorn, 1995). The demise of the species was enabled by its preference for flat lowland habitats which are easily accessible to people and targeted for logging, land conversion, and hunting.

The banteng that we document in Mae Wong probably immigrated from HKK. This is likely for two reasons. First, the banteng area was very close to HKK (about 300 m, Figure 2),

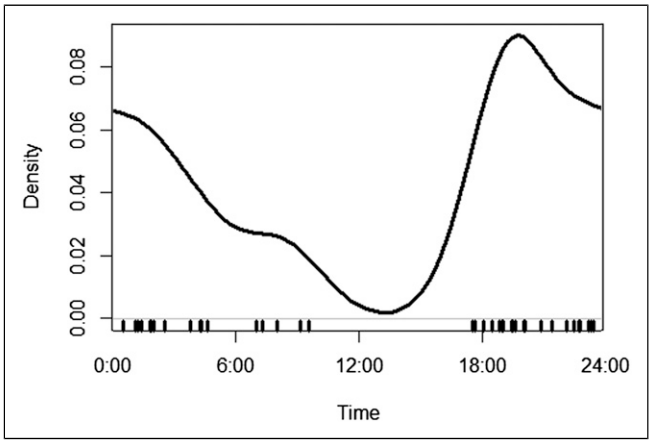


**Figure 4.** Temporal activity pattern of banteng in Mae Wong National Park, Thailand, 2019–2020, based on kernel density analysis of photographs and videos.

and banteng are known to inhabit the northeast corner of HKK across from this zone (pers. comm. S. Duangchantarasiri). Second, banteng were undetected from the remainder of Mae Wong National Park despite extensive surveys over 7 years, suggesting they immigrated from outside. This highlights the role of HKK as a source site for banteng recovery in the Western Forest Complex, and more generally, the importance of landscape connectivity for the recovery of endangered species. Mae Wong is separated from HKK by a mountain ridge rising to nearly 1000 m elevation, which probably represents a significant barrier to banteng dispersal (Prayurasiddhi, 1997). However, there is a low elevation pass (380 m) connecting HKK and Mae Wong just south of where we detected banteng (Figure 2).

We detected banteng in most months and across both seasons (Table 1), suggesting a resident population. Both solitary individuals and herds were observed, reflecting typical banteng social structure (Prayurasiddhi, 1997). The banteng in Mae Wong were strongly nocturnal, similar to wild banteng in Cambodia (Channa & Gray, 2010). The calf we observed was very young, so was likely born in Mae Wong; this indicates that its mother (and her herd) was a resident and not simply dispersing through the area. Importantly, banteng in Mae Wong are breeding—this is significant for future population recovery. Mae Wong has extensive lowland (< 400 m elevation) deciduous forests, covering about 40% of the park. This abundance of this preferred habitat indicates there is ample room for expansion of the banteng population, in terms of both distribution and population size. Population recovery in Mae Wong could be spurred through further immigration from HKK and through breeding by now-resident herds.

The recovery of banteng also has implications for repairing the disrupted food webs of this region (Steinmetz et al., 2021). For example, Mae Wong has a small population of tigers (*Panthera tigris*) whose recovery is currently suppressed by sparse populations of large ungulate prey (Phumanee et al., 2021). Banteng is the preferred food of tigers in nearby HKK (Simcharoen et al., 2018), but this key prey species is missing in Mae Wong. The recovery of banteng in Mae Wong would also benefit tiger conservation.

## Implications for Conservation

We recommend the southeast corner of Mae Wong be designated as a priority zone for banteng conservation, emphasizing protection of the population and limiting habitat disturbance. Artificial saltlicks should be created to supplement banteng diets. Camera trap monitoring should be continued. Outreach to communities near the banteng zone should be conducted to build local pride in the recovery of a long-lost species near their villages and reduce the threat of poaching. In the long-term, a second banteng population should be reintroduced inside Mae Wong, using captive animals or wild ones captured in HKK.

### Acknowledgments

We thank the Department of National Parks, Wildlife and Plant Conservation for study permission and assistance. We thank the Faculty of Forestry, Kasetsart University for support. We thank Weera Uiamsaard, Jonggjit Mungthong, Anake Kaewnim, Thavorn Khankoon, and staff of Mae Wong National Park for supporting the field work. We are grateful to WWF-Germany, WWF International, WWF-Sweden, WWF-US, B. Grimm, and Tiger Beer for funding support.

### Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

### Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This study is supported by Tiger Beer, WWF Sweden, BGrimm, WWF US, WWF Germany, and WWF International

### ORCID iD

Rungnapa Phoonjampa https://orcid.org/0000-0003-1353-3474

### References

Chaichanathong, S., Klinsawat, W., Sukmak, M., Sakulthai, A., Wajjwalku, W., Sripiboon, S., Kaolim, N., Nakbhun, S., Tunpradit, B., Nipanunt, T., Tipkantha, W., Yindee, M., & Thongtip, N. (2021). Genetic characterization of banteng (*Bos javanicus*) populations in Thailand for conservation. *The Thai Journal of Veterinary Medicine*, *51*(4), 647-654. https://doi.org/10.14456/tjvm.2021.78.

Channa, P., & Gray, T.N.E. (2010). Ecology and natural history of banteng in eastern Cambodia: evidence from camera trapping in Mondulkiri Protected Forest and Phnom Prich Wildlife Sanctuary. *Cambodian Journal of Natural History*, *2*, 118–126.

Gairdner, K.G. (1917). Remarks on *Bos sondaicus* (the Tsine or Banting) and on *Bos sondaicus porteri*. *Natural History Bulletin of the Siam Society*, *2*(3), 250-251.

Gardner, P., Hedges, S., Pudyatmoko, S., Gray, TNE., & Timmins, R.J. (2016). Bos javanicus. *The IUCN Red List of Threatened Species 2016: e.T2888A46362970*. https://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T2888A46362970.

Lekagul, B., & McNeely, J.A. (1977). *Mammals of Thailand*. Association for the Conservation of Wildlife.

Phumanee, W., Steinmetz, R., Phoonjampa, R., Bejraburnin, T., Grainger, M., & Savini, T. (2020). Occupancy-based monitoring of ungulate prey species in Thailand indicates population stability, but limited recovery. *Ecosphere*, *11*(9), 1-16. https://doi.org/10.1002/ecs2.3208.

Phumanee, W., Steinmetz, R., Phoonjampa, R., Weingdow, S., Phokamanee, S., Bhumpakphan, N., & Savini, T. (2021). Tiger density, movements, and immigration outside of a tiger source site in Southeast Asia. *Conservation Science and Practice*. *3*(12), e560. https://doi.org/10.1111/csp2.560.

Prayurasiddhi, T. (1997). The ecological separation of gaur (Bos gaurus) and banteng (Bos javanicus. ) in Huai Kha Khaeng Wildlife sanctuary, Thailand. *PhD thesis*. University of Minnesota.

Ridout, M. S., & Linkie, M. (2009). Estimating overlap of daily activity patterns from camera trap data. *Journal of Agricultural, Biological, and Environmental Statistics*, *14*(3), 322–337. https://doi.org/10.1198/jabes.2009.08038.

Ripple, WJ, Newsome, TM, Wolf, C, Dirzo, R, Everatt, KT, Galetti, M, Hayward, MW, Kerley, GI, Levi, T, Lindsey, PA, Macdonald, DW, Malhi, Y, Painter, LE, Sandom, CJ, Terborgh, J, & Van Valkenburgh, B (2015). Collapse of the world's largest herbivores. *Science Advances*, *1*, e1400103–107. https://doi.org/10.1126/sciadv.1400103.

Simcharoen, A., Simcharoen, S., Duangchantrasiri, S., Bump, J., & Smith, J.L.D. (2018). Tiger and leopard diets in western Thailand: evidence for overlap and potential consequencese. *Food Webs*, *15*, 1-6. https://doi.org/10.1016/j.fooweb.2018.e00085.

Srikosamatara, S., & Suteethorn, V. (1995). Populations of gaur and banteng and their management in Thailand. *Natural History Bulletin of the Siam Society*, *43*(1), 55-83.

Steinmetz, R., Seuaturien, N., Intanajitjuy, P., Inrueang, P., & Prempree, K. (2021). The effects of prey depletion on dietary niches of sympatric apex predators in Southeast Asia. *Integrative Zoology*, *16*(1), 19–32. https://doi.org/10.1111/1749-4877.12461.