



## **FINAL REPORT**

**'Human activities and its impact on the vulnerability of the Bornean Banteng  
(*Bos javanicus lowi*) in East Borneo'**

**(2023-2025)**

## 1. Introduction of the project

The Bornean banteng (*Bos javanicus lowi*) is the most endangered mammal in Borneo, and the population keeps declining dramatically due to illegal hunting and habitat loss. Another threat is the interaction with domestic cattle (*Bos indicus*) and domestic water buffalo (*Bubalus bubalis*), and the risk of disease transmission and hybridisation. This project aims to gain knowledge regarding disease transmission dynamics and the impact of overlapping populations of banteng, domestic cattle, and domestic water buffalo on parasite sharing.

The area of Tabin WR, Kulamba WR and Sungai Segama FR was chosen as the project area because it is the only area recording the presence of banteng on the east coast of Sabah, connected by a thin corridor, where the presence of non-confined domestic cattle has raised concerns about hybridisation and inter-species disease transmission.

To assess the rate of interaction among banteng, domestic cattle and domestic water buffalo, a camera trap survey was conducted in the overlapping zones. The presence of parasites was determined by collecting blood and faecal samples. Transmission risk will be assessed using the information of inter-species interactions, frequency of contact, abundance of identified hosts and abundance of parasites.

## **2. Project rationale**

The Bornean Banteng Action Plan for Sabah (2019-2028) identifies hybridisation and disease transmission as emerging threats. Hybridisation with domestic cattle has possibly occurred in the past following the introduction of cow at logging camps. Today, the presence of domestic cattle at oil palm plantations forms a significant risk. Whilst no obvious hybrids have been detected within forest reserves during a previous state-wide survey of banteng, one confirmed feral hybrid banteng-Bali cattle population persists in the southeast of Sabah, within the Felda Kalabakan oil palm plantation. Interspecific hybridisation can result in the disintegration of genetic integrity and the loss of native genetic variation. In addition, the presence of hybrid animals in remaining populations of threatened species may result in legal challenges to their protected status.

Interspecies parasite transmission is a significant, growing, and often underestimated, danger to wildlife conservation and livestock productivity. Gastrointestinal nematodes (worms) that thrive in cattle are frequently shared with related wild bovines, and increasingly sharing recourses can create hotspots for cross-species infection. Parasites from livestock can cause severe illness, reduce reproductive success, and challenge the viability of threatened banteng populations. The overuse of, or improper, anthelmintic (deworming) drugs in cattle can lead to the development of drug-resistant parasites, which can then spread to wild populations, making treatment ineffective for both. While cattle can infect wildlife, wild populations can also act as reservoirs for diseases. Parasite infections in cattle, whether acquired or passed to them, cause significant economic losses through reduced milk production, poor weight gain, and increased treatment costs.

It is therefore important to gain knowledge regarding disease transmission dynamics and the impact of overlapping populations of banteng, domestic cattle, and domestic water buffalo within the recognised high-risk areas.

## **3. Project area**

The Bornean Banteng Action Plan for Sabah (2019-2028) identifies hybridisation and disease transmission as emerging threats, specifically recognising the Tabin and Kulamba Wildlife Reserves as high-risk areas.

The region between the southern border of Kulamba Wildlife Reserve and the Sungai Segama Forest Reserve was selected because previous reports indicate that bantengs visit nearby oil palm plantations. Additionally, the presence of non-confined domestic cattle in the area has raised concerns about the risks of hybridisation and interspecies disease transmission.

In Tabin, the pasture along the old logging road leading to the Tomanggong estate was chosen because it borders nearby plantations and is regularly visited by what may be the last viable herd of bantengs in the area.

## 4. Fieldwork

### 4.1 Reconnaissance of the project site

A reconnaissance was organised in May 2023 to get a better understanding of the project area and the logistics for the fieldwork. Interviews were conducted with the plantations to get information on the activity patterns of their domestic cattle. The team followed the border between the plantations and the protected areas to see if the plantations have fences, to determine potential grazing grounds for the Bornean banteng, to look for wildlife signs, and to determine potential camera trap locations. The team also gathered information on the different permissions needed to conduct the fieldwork.

### 4.2 Camera trap survey

#### Methods

To assess the interaction rate among banteng, domestic cattle and domestic water buffalo, the team established a total of 22 camera trap stations at the interface areas between the plantations (Northbank and LPC), Kulamba WR and Sungai Segama FR (See map on page 13), with locations based on information from previous reconnaissance, potential grazing grounds, and wildlife trails emerging from the forest. Cameras were placed on wooden stakes at a height between 1-1.5m and no baits or lures were used to attract wildlife. Cameras were set to capture images upon motion detection, and were checked and maintained every 2 to 3 months to ensure proper functionality. All images were reviewed for species identification, and false triggers were removed from the data set. The survey ran from August 2023 to July 2025.

In Tabin, the ngo BORA has several camera trap stations along the pasture on the old logging road leading to Tomanggong Estate. Cameras were set up at a height between 1-1.5m and at 2 stations, artificial saltlicks were placed.

#### Results

Banteng was not captured on any of the camera traps, which can either indicate they moved away from the area or they don't exit the forest to graze in the plantation. We confirmed an overlap between domestic cattle (Figure 2) and domestic water buffalo (Figure 1), as camera trap footage showed them sharing the same grazing grounds.

The survey revealed a high diversity of species and a high concentration of lesser adjutant stork (*Leptoptilos javanicus*) (Figure 5) in the area. Other noteworthy wildlife captured are the bearded pig (*Sus barbatus*) (Figure 3), hairy-nosed otter (*Lutra sumatrana*) (Figure 4), silvered langur (*Trachypitecus cristatus*) (Figure 6), orang-utan (Figure 7), and Bornean elephant (Figure 8). For the whole list, see the table on page 9.

At Tabin Wildlife Reserve, BORA confirmed a small banteng herd of approximately 23 individuals. No domestic cattle or domestic water buffalo was captured along the pasture.



Figure 1: Domestic water buffalo (*Bubalus bubalis*)



Figure 2: Domestic cattle (*Bos indicus*)



Figure 3: Bearded pig (*Sus barbatus*)



Figure 4: Hairy-nosed otter (*Lutra sumatrana*)



Figure 5: Lesser adjutant stork (*Leptoptilos javanicus*)



Figure 6: Silvered langur (*Trachypitecus cristatus*)



Figure 7: Orang-utan (*Pongo pygmaeus*)



Figure 8: Bornean elephant (*Elephas maximus borneensis*)

## 4.3 Sampling

### Methods

A small herd of nineteen Brahman x cross cattle inhabits the LPC estate. These cattle, which are not regularly dewormed, graze rotationally throughout the plantation during the day and are confined at night. Additionally, the LPC estate serves as a home to semi-feral water buffalo, roaming unrestricted both day and night. To assess the potential risk of parasite transmission amongst animals that graze the interface area between forest and plantation, we sampled the blood of cattle and collected opportunistic faecal samples. At the same time, we collected faecal samples of banteng at Tabin WR on the old logging road to Tomanggong.

Blood samples were acquired from six female Brahman x cross cattle through venepuncture and preserved in EDTA. Blood smears were performed and stained with Giemsa stain. The smears were analysed in the field for blood parasites, including trypanosomes, intracellular blood parasites (*Anaplasma spp.*, *Babesia spp.*, etc.), and microfilariae.

Faecal samples were opportunistically collected from unidentified bovine hosts along the perimeters of the LPC plantation. Since there was no confirmation of banteng on the camera traps near the perimeter, the opportunistic samples collected were attributed to either buffalo or cattle. At Tabin WR, BORA reported the presence of a herd of approximately twenty-four animals, confirmed by photos from camera traps placed along this road. Cattle or buffalo were never captured by these camera traps, nor did BORA staff visually observe them on the road. This led to the conclusion that faeces discovered in this area belonged to banteng. Fifty-five faecal samples were collected in total. Samples were processed in the field for gastrointestinal parasites, using quantitative flotation and qualitative sedimentation methods. Our examination focused on identifying gastro-intestinal nematodes (roundworms), cestodes (tapeworms), coccidia and flukes.

### Results

No indications of trypanosomes, microfilariae or *Babesia spp.* were identified in any of the blood samples.

Gastrointestinal (strongyle-type) nematodes (Figure 9) were identified in 79% of the faecal samples attributed to either buffalo or cattle, with infection levels ranging from 0 to 100 eggs per gram (EPG). These findings indicate a generally low-level infection. Fluke eggs belonging to the *Paramphistomum spp.* (rumen fluke) (Figure 10) were present in 45% of the faecal samples attributed to either buffalo or cattle. Additionally, the presence of *Buxtonella sulcata* was suspected in a few samples. Clear examples of *Fasciola spp.* (liver fluke) were not observed, nor were *Strongyloides*, coccidia, cestodes visualised.

Gastrointestinal (strongyle-type) nematodes were identified in 77% of the faecal samples attributed to banteng, with infection levels ranging from 0 to 240 eggs per gram (EPG). These findings indicate a generally low-level infection. In addition to the typical strongyle-type eggs, other parasites were also detected. These include coccidia (possibly *Eimeria spp.*) (Figure 11), tapeworms (possibly *Moniezia spp.*) (Figure 12), and in one sample, a *Trichuris spp.* egg (Figure 13). Fluke eggs (*Paramphistomum* and *Fasciola spp.*) were not observed.



Figure 9: Strongyle-type egg (magnification x10)

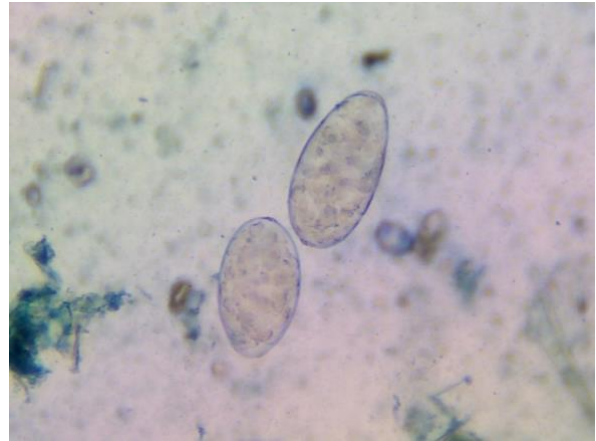


Figure 10: *Paramphistomum* spp. (magnification x10)



Figure 11: Coccidia oocyst (magnification x10)



Figure 12: Unknown tapeworm egg (magnification x10)

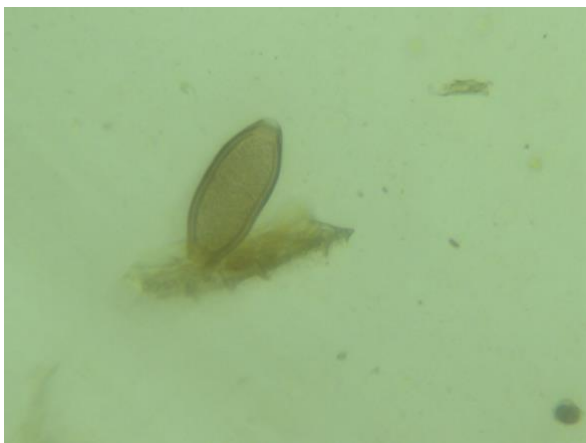


Figure 13: *Trichuris* spp. egg (magnification x40)

## 5. Conclusion

The team didn't detect any interaction among banteng, domestic cattle and domestic water buffalo during this project.

According to our camera trap survey, banteng is not present at the project site between the southern border of Kulamba Wildlife Reserve and the Sungai Segama Forest Reserve, but domestic cattle and domestic water buffalo share the same grazing grounds. Therefore, there is a low risk for hybridisation and interspecies parasite transmission between the wild banteng and the domesticated bovines. Gastrointestinal (strongyle-type) nematodes were identified in 79% of the faecal samples attributed to either buffalo or cattle. Fluke eggs belonging to the *Paramphistomum spp.* (rumen fluke) were present in 45% of the faecal samples attributed to either buffalo or cattle. Additionally, the presence of *Buxtonella sulcata* was suspected in a few samples. Clear examples of *Fasciola spp.* (liver fluke) were not observed, nor were *Strongyloides*, coccidia, cestodes visualised. Infection levels ranged from 0 to 100 eggs per gram (EPG). These findings indicate a generally low-level infection and no immediate reason for concern.

According to camera trap data from BORA, a small banteng herd of approximately 23 individuals grazes at the pasture at our project site in Tabin Wildlife Reserve, but domestic cattle and domestic water buffalo are not present. Therefore there is a low risk for hybridisation and interspecies parasite transmission between the wild banteng and the domesticated bovines. Gastrointestinal (strongyle-type) nematodes were identified in 77% of the faecal samples attributed to banteng, with infection levels ranging from 0 to 240 eggs per gram (EPG). In addition to the typical strongyle-type eggs, other parasites were also detected. These include coccidia (possibly *Eimeria spp.*), tapeworms (possibly *Moniezia spp.*), and in one sample, a *Trichuris spp.* egg. Fluke eggs (*Paramphistomum* and *Fasciola spp.*) were not observed. These findings indicate a moderate-level infection. There is no immediate concern, but given the combination of different parasite types, it is recommended to keep monitoring this herd for an increase in infection levels.

## 6. Results camera trap survey

No	Camera trap	Location	Common name	Scientific name
1	BTNLPC01	LPC	Bearded pig	<i>Sus barbatus</i>
			Domestic cattle	<i>Bos indicus</i>
			Lesser adjutant stork	<i>Leptoptilos javanicus</i>
			Little egret	<i>Egretta garzetta</i>
			Long-tailed macaque	<i>Macaca fascicularis</i>
			Pig-tailed macaque	<i>Macaca nemestrina</i>
			Purple heron	<i>Ardea purpurea</i>
			Sambar deer	<i>Rusa unicolor</i>
			White-breasted waterhen	<i>Amaurornis phoenicurus javanicus</i>
2	BTNLPC02	LPC	Domestic cattle	<i>Bos indicus</i>
			Domestic water buffalo	<i>Bubalus bubalis</i>
			Lesser adjutant stork	<i>Leptoptilos javanicus</i>
			Long-tailed macaque	<i>Macaca fascicularis</i>
			Malayan civet	<i>Viverra zangalunga</i>
			Silvered langur	<i>Trachypitecus cristatus</i>
3	BTNLPC03	LPC	Cattle egret	<i>Bubulcus ibis</i>
			Domestic water buffalo	<i>Bubalus bubalis</i>
			Greater coucal	<i>Centropus sinensis</i>
			Lesser adjutant stork	<i>Leptoptilos javanicus</i>
			Little egret	<i>Egretta garzetta</i>
			Long-tailed macaque	<i>Macaca fascicularis</i>
			Pig-tailed macaque	<i>Macaca nemestrina</i>
			Sambar deer	<i>Rusa unicolor</i>
4	BTNLPC04	LPC	Domestic water buffalo	<i>Bubalus bubalis</i>
			Lesser adjutant stork	<i>Leptoptilos javanicus</i>
			Long-tailed macaque	<i>Macaca fascicularis</i>
			Pig-tailed macaque	<i>Macaca nemestrina</i>
5	BTNLPC05	LPC	Long-tailed macaque	<i>Macaca fascicularis</i>
			Pig-tailed macaque	<i>Macaca nemestrina</i>
			Sambar deer	<i>Rusa unicolor</i>
6	BTNLPC06	LPC	Lesser adjutant stork	<i>Leptoptilos javanicus</i>
			Long-tailed macaque	<i>Macaca fascicularis</i>
			Pig-tailed macaque	<i>Macaca nemestrina</i>
7	BTNLPC07	LPC	Buffy fish owl	<i>Ketupa ketupu</i>
			Domestic water buffalo	<i>Bubalus bubalis</i>
			Hairy-nosed otter	<i>Lutra sumatrana</i>
			Leopard cat	<i>Prionailurus bengalensis</i>
			Lesser adjutant stork	<i>Leptoptilos javanicus</i>
			Long-tailed macaque	<i>Macaca fascicularis</i>
			Myna	<i>Acridotheres sp.</i>
			Pig-tailed macaque	<i>Macaca nemestrina</i>
			White-breasted waterhen	<i>Amaurornis phoenicurus javanicus</i>

No	Camera trap	Location	Common name	Scientific name
8	BTNLPC08	LPC	Cattle egret	<i>Bubulcus ibis</i>
			Domestic cattle	<i>Bos indicus</i>
			Domestic water buffalo	<i>Bubalus bubalis</i>
			Lesser adjutant stork	<i>Leptoptilos javanicus</i>
			Long-tailed macaque	<i>Macaca fascicularis</i>
			Sambar deer	<i>Rusa unicolor</i>
9	BTNLPC09	LPC	Domestic water buffalo	<i>Bubalus bubalis</i>
			Lesser adjutant stork	<i>Leptoptilos javanicus</i>
			Long-tailed macaque	<i>Macaca fascicularis</i>
			Pig-tailed macaque	<i>Macaca nemestrina</i>
			Prevost's squirrel	<i>Callosciurus prevostii pluto</i>
			Purple heron	<i>Ardea purpurea</i>
			Sambar deer	<i>Rusa unicolor</i>
			Silvered langur	<i>Trachypitecus cristatus</i>
			White-breasted waterhen	<i>Amaurornis phoenicurus javanicus</i>
10	BTNLPC10	LPC	Domestic water buffalo	<i>Bubalus bubalis</i>
			Greater coucal	<i>Centropus sinensis</i>
			Hairy-nosed otter	<i>Lutra sumatrana</i>
			Leopard cat	<i>Prionailurus bengalensis</i>
			Lesser adjutant stork	<i>Leptoptilos javanicus</i>
			Long-tailed macaque	<i>Macaca fascicularis</i>
			Monitor lizard	<i>Varanus salvator</i>
			Pig-tailed macaque	<i>Macaca nemestrina</i>
			Purple heron	<i>Ardea purpurea</i>
			Red junglefowl	<i>Gallus gallus</i>
			White-breasted waterhen	<i>Amaurornis phoenicurus javanicus</i>
11	BTNNRB01	Northbank	/	/
12	BTNNRB02	Northbank	Lesser adjutant stork	<i>Leptoptilos javanicus</i>
			Long-tailed macaque	<i>Macaca fascicularis</i>
			Malayan civet	<i>Viverra zibetha</i>
			Pig-tailed macaque	<i>Macaca nemestrina</i>
			Red junglefowl	<i>Gallus gallus</i>
			Sambar deer	<i>Rusa unicolor</i>
			White-breasted waterhen	<i>Amaurornis phoenicurus javanicus</i>
13	BTNNRB03	Northbank	Pig-tailed macaque	<i>Macaca nemestrina</i>
14	BTNNRB04	Northbank	Lesser adjutant stork	<i>Leptoptilos javanicus</i>
			Pig-tailed macaque	<i>Macaca nemestrina</i>
15	BTNLPC11	LPC	Long-tailed macaque	<i>Macaca fascicularis</i>
			Bornean elephant	<i>Elephas maximus borneensis</i>
			Sambar deer	<i>Rusa unicolor</i>
			Domestic water buffalo	<i>Bubalus bubalis</i>
			Orangutan	<i>Pongo pygmaeus</i>
			Pig-tailed macaque	<i>Macaca nemestrina</i>
			Domestic cattle	<i>Bos indicus</i>
			Cattle egret	<i>Bubulcus ibis</i>
16	BTNLPC12	LPC	Lesser adjutant stork	<i>Leptoptilos javanicus</i>
			Long-tailed macaque	<i>Macaca fascicularis</i>
			Domestic water buffalo	<i>Bubalus bubalis</i>
			Bornean elephant	<i>Elephas maximus borneensis</i>

			Cattle egret	<i>Bubulcus ibis</i>
			Pig-tailed macaque	<i>Macaca nemestrina</i>
			Sambar deer	<i>Rusa unicolor</i>
			Great egret	<i>Ardea alba</i>
			Purple heron	<i>Ardea purpurea</i>
			Malay civet	<i>Viverra zangalunga</i>
			Leopard cat	<i>Prionailurus bengalensis</i>
17	BTNLPC13	LPC	Lesser adjutant stork	<i>Leptoptilos javanicus</i>
			Long-tailed macaque	<i>Macaca fascicularis</i>
			Monitor lizard	<i>Varanus salvator</i>
			Bornean elephant	<i>Elephas maximus borneensis</i>
			Red junglefowl	<i>Gallus gallus</i>
			Pig-tailed macaque	<i>Macaca nemestrina</i>
			Short-tailed mongoose	<i>Urva brachyurus</i>
			Purple heron	<i>Ardea purpurea</i>
			Sambar deer	<i>Rusa unicolor</i>
18	BTNLPC14	LPC	Long-tailed macaque	<i>Macaca fascicularis</i>
			Lesser adjutant stork	<i>Leptoptilos javanicus</i>
			Pig-tailed macaque	<i>Macaca nemestrina</i>
			Red junglefowl	<i>Gallus gallus</i>
			Silvered langur	<i>Trachypithecus cristatus</i>
			Domestic cattle	<i>Bos indicus</i>
			Bornean elephant	<i>Elephas maximus borneensis</i>
			Domestic water buffalo	<i>Bubalus bubalis</i>
19	BTNLPC15	LPC	Lesser adjutant stork	<i>Leptoptilos javanicus</i>
			Bornean elephant	<i>Elephas maximus borneensis</i>
			Pig-tailed macaque	<i>Macaca nemestrina</i>
			Oriental pied hornbill	<i>Anthraceros albirostris</i>
			Long-tailed macaque	<i>Macaca fascicularis</i>
20	BTNLPC17	LPC	Pig-tailed macaque	<i>Macaca nemestrina</i>
			Long-tailed macaque	<i>Macaca fascicularis</i>
			Lesser adjutant stork	<i>Leptoptilos javanicus</i>
			Small-clawed otter	<i>Aonyx cinereus</i>
			Domestic cattle	<i>Bos indicus</i>
			Cattle egret	<i>Bubulcus ibis</i>
			Purple heron	<i>Ardea purpurea</i>
			Malay civet	<i>Viverra zangalunga</i>
			Leopard cat	<i>Prionailurus bengalensis</i>
			Bearded pig	<i>Sus barbatus</i>
			Silvered langur	<i>Trachypithecus cristatus</i>
			Domestic water buffalo	<i>Bubalus bubalis</i>
21	BTNLPC18	LPC	Lesser adjutant stork	<i>Leptoptilos javanicus</i>
			Long-tailed macaque	<i>Macaca fascicularis</i>
			Pig-tailed macaque	<i>Macaca nemestrina</i>
			Malay civet	<i>Viverra zangalunga</i>
			Leopard cat	<i>Prionailurus bengalensis</i>
			Monitor lizard	<i>Varanus salvator</i>
			Grey-headed fish eagle	<i>Ichthyophaga ichthyaetus</i>
			Domestic water buffalo	<i>Bubalus bubalis</i>
			Cattle egret	<i>Bubulcus ibis</i>

			Red junglefowl	<i>Gallus gallus</i>
22	BTNLPC19	LPC	Leopard cat	<i>Prionailurus bengalensis</i>
			Long-tailed macaque	<i>Macaca fascicularis</i>
			Bornean elephant	<i>Elephas maximus borneensis</i>
			Lesser adjutant stork	<i>Leptoptilos javanicus</i>
			Monitor lizard	<i>Varanus salvator</i>
			Domestic water buffalo	<i>Bubalus bubalis</i>
			Small-clawed otter	<i>Aonyx cinereus</i>
			Domestic cattle	<i>Bos indicus</i>
			Purple heron	<i>Ardea purpurea</i>
			Cattle egret	<i>Bubulcus ibis</i>
			Silvered langur	<i>Trachypithecus cristatus</i>
			White-breasted waterhen	<i>Amaurornis phoenicurus javanicus</i>

## Kulamba WR and Sungai Segama FR: camera trap locations

