Status of two species of threatened wild cattle (*Bos gaurus* and *Bos javanicus birmanicus)* in North Zamari Wildlife Sanctuary, Bago Region, Myanmar

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Abstract

We conducted a camera-trap survey from March to June 2020 to determine the relative abundance of banteng and gaur in the North Zamari Wildlife Sanctuary (NZWS) in Bago region of Myanmar. The photo-captures suggested that the banteng was more widespread than the gaur, which was restricted to the southern part of the wildlife sanctuary. We present an assessment of their status in terms of spatial occupancy and relative abundance, the threats they face, and the conservation actions needed to secure their populations in the area. With increased protection and upon population recovery, NZWS could host a globally significant population of the endangered banteng.

Introduction

The current population status of gaur (*Bos gaurus)* and the banteng (*Bos javanicus birmanicus*), two species that occurred commonly in the past (Wharton 1968, Yin 1955) and still persist in a few locations in Myanmar, is poorly known. Wharton (1968) cites older literature and provides a map of known localities and probable distribution range of banteng in Myanmar. He included most of the relatively dry tropical lowland parts of Myanmar, comprising of dry and moist deciduous forests, including the Bago Yoma (Bago mountain range) in the probable range of banteng. Gaur distribution overlapped with banteng, but was stated to be much wider, including the hilly tracts and wet evergreen forests across Myanmar. Surveys completed nearly two decades ago indicated that gaur was widespread and found in 11 out of 17 sites that were surveyed across Myanmar while preparing the National Tiger Action Plan, while banteng was highly restricted and was found in only three out of the 17 sites (Lynam, Khaing and Zaw, 2006; Lynam, 2003). This list of sites includes the Bago Yoma in the extant range map, but does not consider any population in Myanmar as globally significant. Also, it considers the banteng population to be generally declining in Myanmar, in line with the rest of the banteng range in Southeast Asia.

We conducted camera-trap surveys in North Zamari Wildlife Sanctuary (NZWS), Bago Yoma range in central Myanmar, to determine the diversity of large mammals, and confirm the persistence of gaur and banteng in the area. We also assessed their spatial occupancy and relative abundance. This was a collaborative effort of the Forest Department, WWF-Myanmar, and Friends of Wildlife (FOW).

Study Area

The NZWS has an area of 981 km^2, and is largely comprised of mixed deciduous and dry deciduous forests. It lies on the western side of the Bago Yoma range, which runs north to south in central Myanmar (Fig. 1). NZWS is severely degraded as a consequence of heavy logging (often for teak, *Tectona grandis*) in the past, accompanied by seasonal fires. Presently, it is a vast expanse of secondary growth, with a high abundance of bamboo.

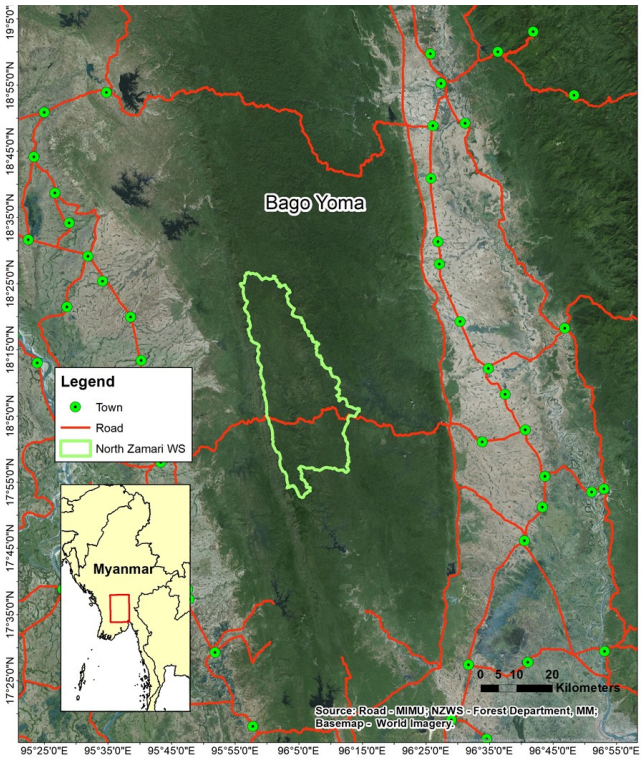

Figure 1. *The outer boundary of North Zamari Wildlife Sanctuary (NZWS) laid over Google Earth satellite imagery showing the relatively abundant vegetation cover (green) of the Bago Yoma mountain range. The inset map shows the study area location in Myanmar.*

A 10-year logging ban came into effect in Bago Yoma in 2017 and forest restoration efforts are being undertaken by the Forest Department. There is a two-lane road passing through the NZWS from east to west that has existed long before the NZWS was gazetted in 2014.

Methods

We conducted a camera-trap survey in NZWS, between March and June 2020, for assessing the diversity of large mammals. An earlier unpublished survey conducted in 2018 by the Forest Research Institute (FRI) of Forest Department and FOW showed that large mammals, including the two wild cattle species, occurred in the area (Table 1). We divided NZWS into 63 grid cells of 4 x 4 km^2 each and deployed a camera-trap in each cell to ensure survey coverage of all areas of the sanctuary (Fig. 4a,4b). We placed camera-traps at or within 500 m of the centre point of each cell, in locations expected to be used by wildlife species (along trails, near stream-beds, etc.). In this way, the camera-traps were evenly distributed and were approximately 4 km apart from each other. We assumed that this spacing would be suitable to cover the individual home ranges of many large mammals present in the area. Camera-traps remained in the 'ON' state throughout the day (day and night) and 24-hours constituted a 'trap-day' of survey effort. Photographic captures were considered 'independent' detections only when animals of the same species were captured 30-minutes apart, unless they were of different sex or otherwise clearly individually distinguishable.

Results and Discussion

Although 63 camera-traps were deployed for

the survey, data from only 57 camera-traps could be retrieved, as six camera-traps were either destroyed by fire or were stolen. This resulted in a survey effort of 4,267 camera trap -days. 25 species of mammals and 14 species of birds were detected in the camera-traps (Table 1, Figs. 2 and 3). In addition, domestic animals such as dogs, cattle, and humans (involved in different types of activities such as illegal hunting, illegal logging, and NTFP collection) were captured in the camera-traps.

Previously unpublished data from the 2018 survey in NZWS is presented here for comparison with the results from this survey (Table 1).

Figure 2 (above): Solitary gaur captured in a camera-trap in the southern part of NZWS in March 2020.

Figure 3 (below): Female banteng captured in a camera-trap in the southern part of NZWS in March 2020.

Table 1. Key characteristics of the camera-trap surveys and frequency of banteng detections in North Zamari Wildlife Sanctuary, Bago region, Myanmar.

Survey characteristics	2018	2020
Number of camera-traps deployed	16	63
Number of camera-traps retrieved and used in analysis	11	57
Survey duration	82 days (Feb – April 2018)	118 days (Mar – Jun 2020)
Number of medium and large mammal species identified from camera-trap photos	15	25
Number of bird species identified from camera-trap photos	4	14
Other animals, and activities of humans identified from photos	Dogs, cattle, humans (illegal hunters, illegal loggers, and NTFP-collectors)	Dogs, cattle, humans (illegal hunters, illegal loggers, and NTFP-collectors)
Camera-trap effort (trap-days)	721	4,267
Area covered (minimum convex polygon area)	229 km^2	890 km^2
Number of banteng detections and number of camera-trap locations with detections	4 captures in 3 locations	25 captures in 11 locations
Number of gaur detections and number of camera-trap locations with detections	1 capture	14 captures in 2 locations
Minimum distance between banteng detections	5.9 km	3.8 km
Maximum distance between banteng detections	20.2 km	48.6 km
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Due to the increased survey effort in 2020, in terms of area covered, camera-traps placed, and survey period, banteng and gaur were detected at more locations and more frequently than in the 2018 survey (Table 1; Figs. 4a and 4b). There were 25 independent banteng captures in 11 camera-trap locations in 2020, as opposed to four independent captures in three camera-trap locations in 2018 (Fig. 4a). Out of eleven locations where banteng were detected in 2020, solitary animals were recorded in eight locations and groups of three animals were recorded in three locations. There were 14 independent captures of gaur in two camera-trap locations in 2020, as compared to a single detection in 2018 (Fig. 4b). Out of the two locations where gaur was detected in 2020, solitary gaur were found in two locations, and a pair was captured in one location. These results indicate that the 2020 survey, covering whole of NZWS, gave a better representative picture of the occupancy and relative abundance of the wild cattle species.

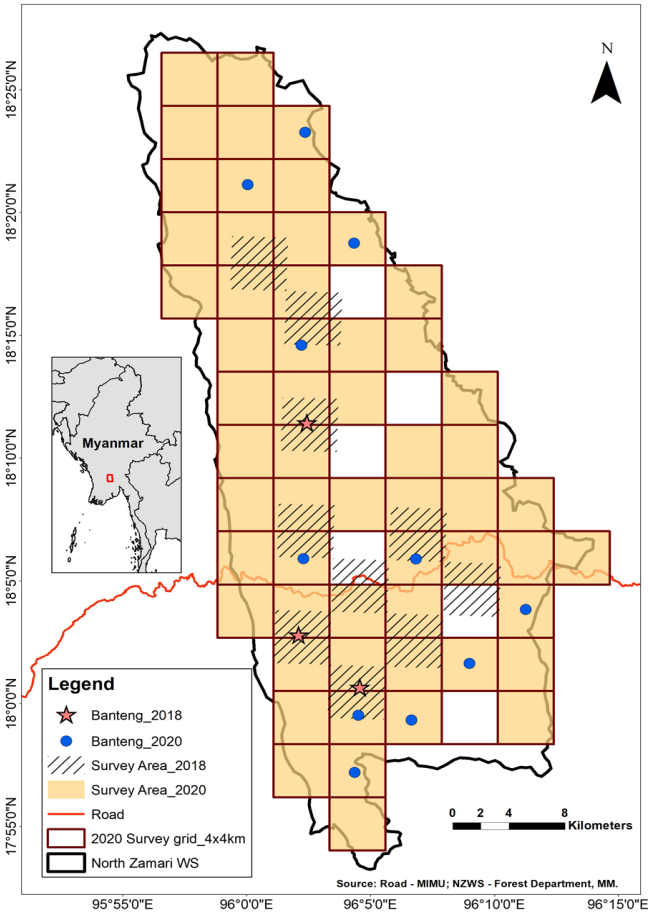
Banteng were distributed across the length of NZWS, with a naïve occupancy of 19.3% (Fig. 4a). On the other hand, gaur distribution appeared to be confined to a few locations, with a naïve occupancy of 3.5% (Fig. 4b). Gaur were detected only in the southern part of NZWS in both years. Hunters were recorded in several camera-traps, indicating that hunting pressure may be high. Furthermore, our survey data showed that both banteng and gaur co-occurred in southern NZWS, where a single camera-trap captured both the species, although at different times.

Both the wild cattle species were detected from early evenings to late mornings (3 PM to 9 AM), with very few detections between 9 AM to 3 PM during the survey period that is also the hot and dry season (Fig. 5). This concurred with the activity patterns reported from many sites in Asia where gaur were known to graze in the late evenings until late mornings in open grasslands *(A. Christy Williams, personal observations).* There was no discernible difference in activity pattern between banteng and gaur, but the limited number of detections of gaur limits the robustness of this comparison.

Threats

Evidence of human activities such as illegal hunting and illegal logging were detected in camera-traps. Habitat loss and hunting are two major threats to the two wild cattle species across their distribution range in Southeast Asia (Gardner et al. 2016). Hunting may be a severe threat in NZWS, as hunters were recorded in 26 of the 57 camera-trap locations. This indicated that both gaur and banteng maybe target species for the hunters in NZWS. In addition, detection of gaur only in the southern NZWS in both study years suggested that gaur maybe less resilient to hunting pressure than banteng.

Habitat loss from illegal logging may be a threat presently. However, the historical habitat loss may have played a more significant role than the recent habitat loss for both the species. NZWS comprises mostly of rougher



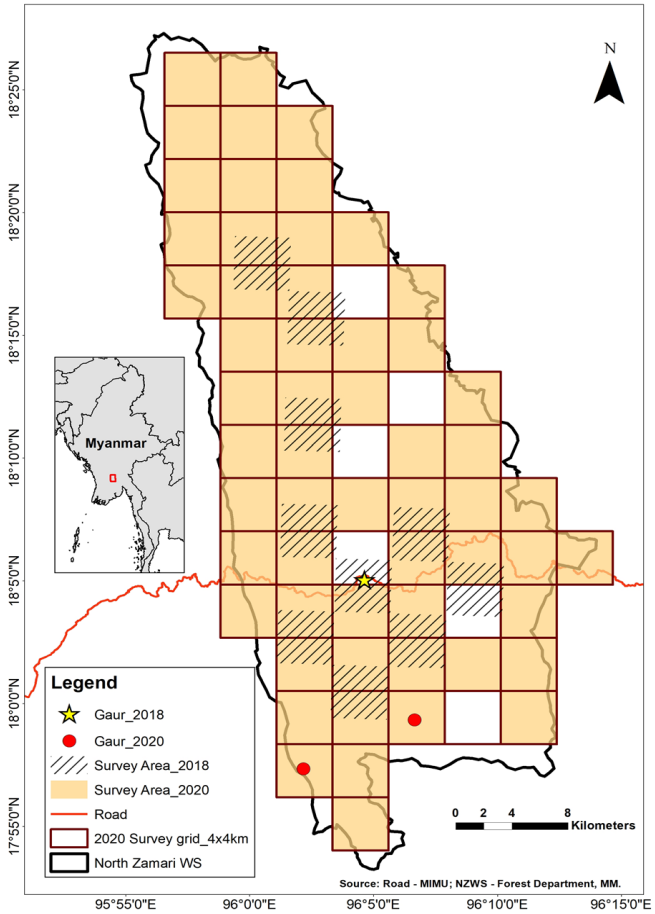


Figure 4a(left). Camera-trap locations that captured banteng in 2018 and 2020 surveys, overlaid on the grid cells surveyed in the two years, and on the NZWS boundary.

Figure 4b(right). Camera-trap locations that captured gaur in 2018 and 2020 surveys, overlaid on the grid cells surveyed in the two years, and on the NZWS boundary.

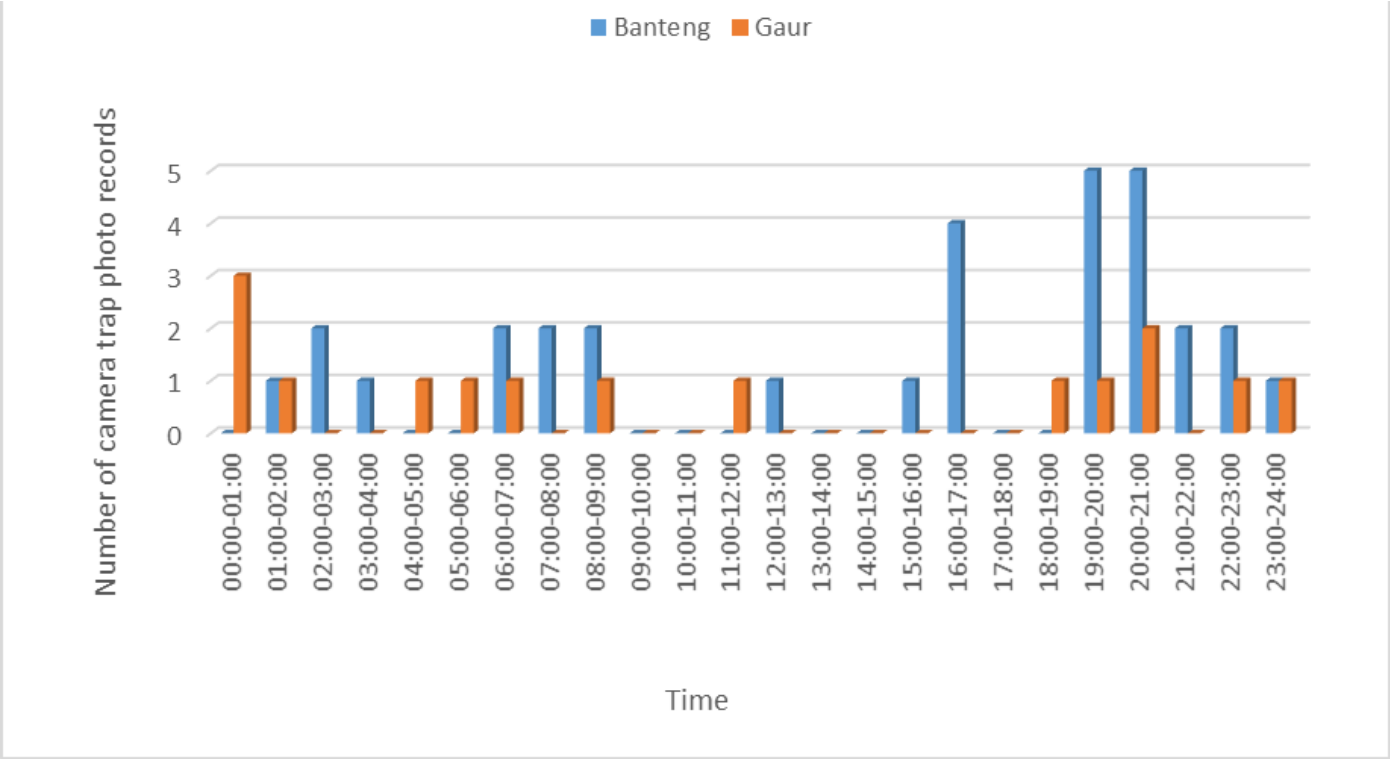


Figure 5: Activity pattern of banteng and gaur inferred from camera-trap detections in NZWS in 2020.

terrain and is a less suitable habitat for both species, especially for banteng, which enjoy flatter terrain and is largely a grazer (Gardner *et al.*, 2016).

As the survey was conducted during the peak of hot and dry season, low intensity forest fires were widespread across the sanctuary, with fire incidents recorded in 29 camera-traps. While low intensity forest fire is not a direct threat to either species and may even be helpful by creating grazing areas with new shoots, it creates open areas that provide people with easy access for hunting, or for farming in the forest periphery.

Farming was seen in the northern peripheries of NZWS, where banteng presence was also recorded. Farming poses a threat to the wild cattle populations where there is overlap with domestic cattle that can be a source of diseases and parasites. Domestic cattle can also pose a potential genetic threat to banteng as interbreeding is possible and if introgression occurs.

Conservation significance of the banteng population in NZWS

Camera-trap photo capture rate (a.k.a detection rate) of banteng from the 2020 survey was estimated as 0.59 captures per 100 trap-days of effort. This rate was compared with other sites in mainland Southeast Asia where suitable data is available to allow the estimation of capture rates (Table 2). The comparative data suggests that the banteng population in NZWS may be substantially lower in abundance than some of the populations considered globally significant, such as the Mondulkiri Protection Forest of Cambodia, and Huai Kha Khaeng Wildlife Sanctuary of Thailand (Phan, Prum and Gray 2010, Gray and Phan 2011, Gardner et al. 2016, Saisamorn et al. 2019).

Table 2. Camera-trap capture (detection) rates of banteng and gaur in North Zamari Wildlife Sanctuary, Myanmar, in comparison with sites surveyed by various authors across mainland Southeast Asia over the past decade.

Study Sites		No. of independent captures	Camera-trap effort	Capture rate (No. independent captures / camera-trap effort)*100	Study period	Reference
Banteng	North Zamari Wildlife Sanctuary, Bago region, Myanmar	25	4,267	0.59	March to June 2020	**This study**
	Green Island, Sambour district of Kratie Province, Cambodia	31	6,515	0.48	January 2017 – December 2019	Chan *et al.* 2020
	Phnom Prich Wildlife Sanctuary, Mondulkiri province, Cambodia	65	2,717	2.39	December 2008 – August 2009	Gray and Phan 2011
	Mondulkiri Protection Forest and Phnom Prich Wildlife Sanctuary, Mondulkiri province, Cambodia	160	7,295	2.19	January – December 2009	Phan, Prum and Gray 2010
	Pang Sida National Park, Thailand	7	28,698	0.02	2010 – Feb 2017	Ash et al. 2020
	Ta Phraya National Park, Thailand	11	5,764	0.19	2013 - 2015	Ash et al. 2020
	Huai Kha Khaeng Wildlife Sanctuary, Thailand	137	6,225	2.2	Jan – May 2013, and Jan – May 2015	Saisamorn et al. 2019
Gaur	North Zamari Wildlife Sanctuary, Bago region, Myanmar	14	4,267	0.33	March to June 2020	**This study**
	Phnom Prich Wildlife Sanctuary, Mondulkiri province, Cambodia	9	2,717	0.33	December 2008 – August 2009	Gray and Phan 2011
	Mondulkiri Protection Forest and Phnom Prich Wildlife Sanctuary, Mondulkiri province, Cambodia	26	7,295	0.36	January – December 2009	Phan, Prum and Gray 2010
	Dong Yai Wildlife Sanctuary, Thailand	119	4,871	2.44	2012 – Feb 2017	Ash et al. 2020
	Khao Yai National Park, Thailand	292	7,621	3.83	2010 – 2016	Ash et al. 2020
	Pang Sida National Park, Thailand	815	28,698	2.84	2010 – Feb 2017	Ash et al. 2020
	Thap Lan National Park, Thailand	422	32,955	1.28	2008 – Feb 2017	Ash et al. 2020
	Ta Phraya National Park, Thailand	173	5,764	3.0	2013 - 2015	Ash et al. 2020

While the population in Mondulkiri, Cambodia is facing a serious threat from intensive and indiscriminate snaring and other forms of poaching (Gray et al. 2018), the population in Huai Kha Khaeng continues to be well protected. The capture rate of banteng in NZWS is also lower than the populations in the severely logged and re-growing rainforest habitats of Borneo (Journeaux et al. 2018).

However, the NZWS capture rate is higher than other sites such as the Ta Phraya National Park in Thailand (Table 2; Ash et al. 2020). Moreover, the NZWS population has persisted despite severe hunting pressure and inade-

quate conservation attention, and it still has relatively widespread occupancy in NZWS.

This suggests that banteng population recovery is likely and it has potential to become a significant global population, given protection and assisted in population recovery through habitat and population management measures. The capture rate of gaur in NZWS, as expected, is substantially lower than most populations in Thailand (Ash et al. 2020), but comparable to the already suppressed populations of gaur in Mondulkiri, Cambodia (Table 2).

We acknowledge that the camera-trap detection rate is not a robust indicator of animal abundance, particularly for cross-site comparisons, given the differences in detection probability, vegetation cover, incomparable survey design, and other influencing factors among the different sites. However, given that the effort to estimate more robust indices of abundance is yet to begin in NZWS, and the general paucity of data on local population abundance of the species across its range, we present this comparison to highlight the conservation significance of this little known population.

Conclusion

There is significant potential for recovery of this banteng population and this would contribute to the global effort to conserve the banteng. There is an urgent need for better protection of this little-known population. NZWS was primarily established as an elephant reserve, a species that prefers flat terrain. Therefore, expanding the boundary to include the surrounding flatter areas that include grasslands will benefit both wild cattle species and the elephant population surviving along the Bago Yoma range.

WWF is currently working with Forest Department to set up Myanmar's first Ranger Training Institute in NZWS and this will contribute to improved protection for the wildlife in NZWS. Further, we need more robust estimates of banteng and gaur populations in NZWS. Therefore, continuing the camera-trapping surveys regularly is necessary to understand the population sizes, the occupancy dynamics of these two species, and their response to threats. This camera-trap survey has provided an important update on the occurrence of 25 species of mammals, as well as the extent of key threats. It is our expectation that this information will be used by the Myanmar Forest Department to take management actions to secure the viability of the banteng and gaur populations in the area. With increased protection and upon population recovery, this area could host a globally significant population of banteng.

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