BULLetin

Journal of the IUCN SSC Asian Wild Cattle Specialist Group

IUCN SSC Species Survival Commission AWCSG Asian Wild Cattle Specialist Group

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IUCN Asian Wild Cattle Specialist Group

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Cover Photo

Wild water buffalo, Kaziranga National Park © Nejib Ahmed

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EDITOR'S NOTE

by Corinne Bailey, Programme Officer, IUCN SSC Asian Wild Cattle Specialist Group

Welcome to the fourth issue of BULLetin, the newsletter of the IUCN SSC Asian Wild Cattle Specialist Group (AWCSG). In BULLetin, we present novel research on the ecology and conservation of all Asian wild cattle species, as well as sharing stories about all activities of conservation interest involving Asian wild cattle.

This issue highlights field research conducted and Asian wild cattle conservation. Here, we have the results of a study comparing methods in surveying populations of Critically Endangered tamaraw (Bubalus *mindorensis*) in Iglit Baco in Mindoro, as well as a very interesting preliminary case study of banteng (*Bos javanicus*) activity and ecology within land concessions in Cambodia. These reports and research will provide crucial information to help monitor and manage the wild populations of these species.

This issue has a range of news and reports of applied conservation actions to preserve and manage Asian wild cattle species. This includes further information about banteng community conservation with Wildlife Alliance in Prambei Mon, briefly described in the last issue. We also have an update on the Action Indonesia Global Species Management Plans (GSMPs), including the progress in collaborative breeding for *ex situ* conservation of anoa, banteng, babirusa and Sumatran tiger, and details of Action Indonesia Day 2020, which will take place on August 16th. For information on how to participate visit the website at www.actionindonesiagsmp.org

Action Indonesia Day Activities at Taman Safari Indonesia Bali Safari and Marine Park

The fifth issue of BULLetin will be published at the end of the year. We are keen to hear from you if you would like to contribute—this could be a novel research article, an update from the field, an update on your work or just about anything else relating to Asian wild cattle. Please get in touch via social media or contact me at c.bailey@chesterzoo.org.

Keep up to date with our activities and other Asian wild cattle news on our website (www.asianwildcattle.org) and social media (Facebook: IUCN Asian Wild Cattle Specialist Group, Twitter: @IUCN_WildCattle and Instagram: @iucn_wildcattle). We hope you enjoy this issue, and look forward to hearing from you. Finally, we would like to extend our wishes to all of our readers during these challenging times of the Covid-19 pandemic.

NEWS AND UPDATES

Action Indonesia GSMP Update

By Corinne Bailey, Programme Officer, IUCN SSC Asian Wild Cattle Specialist Group

Action Indonesia is a collaborative partnership for the conservation of banteng, anoa, babirusa and Sumatran tiger. The partnership aims to achieve safe and stable populations of these species *in situ* and to provide back-up *ex situ* populations.

Breeding Success

A primary objective of the Action Indonesia Global Species Management Plans (GSMPs) is to reach "demographically and genetically healthy *ex situ* populations". Two sets of breeding and transfer recommendations have been produced to date, with the second set produced in 2018. So far, 3 anoa, 11 banteng, 4 babirusa and 2 Sumatran tigers have been born in the second set of breeding recommendations, with a total of 30 recommended births since the process began in 2016.

New recommended births in Indonesia are important steps forward in the goal of maintaining healthy global *ex situ* populations as they have a number of "founder" animals from wild populations, which increases genetic diversity. This indicates a commitment by zoos to utilise and follow breeding recommendations, and is a positive step towards *ex situ* conservation of these species.

Young banteng at Ragunan Zoo. Photo: James Burton

Action Indonesia Day 2020

Following the success and strong participation of last year's Action Indonesia Day, the Action Indonesia GSMPs will be holding another awareness raising day for banteng, anoa and babirusa this year, with zoos worldwide taking part. Action Indonesia Day will take place on **August 16, 2020** and will look slightly different within the constraints of the current Covid-19 pandemic. Many zoos are planning to take Action Indonesia Virtual and have smaller in-park activities and awareness campaigns. Please save the date and join us for this on August 16th! For more information on how to participate, visit the website at actionindonesiagsmp.org/ and follow #ActionIndonesiaDay on social media.

Action Indonesia Day 2019 at Lembeh Hijau Zoo

Buffalo Road Trip

by Lottie Siddle, Field Programmes Intern, Chester Zoo

In May, a pair of wild buffalo (*Bubalus* arnee) made the 1900km journey from Manas National Park, Assam, to Barnawapara Wildlife Sanctuary (BWS) in Chhattisgarh. The Endangered species has been in decline in Chhattisgarh, where it is the state animal, as a result of habitat degradation and hybridisation with domestic buffalo. Part of the Central Indian Wild Buffalo Recovery Plan, a collaboration between the Wildlife Trust of India and the Chhattisgarh Forest Department, the hope is that this translocation will boost the breeding success of the buffalo population in Udanti-Sitanadi Tiger Reserve, Chhattisgarh, which has suffered from a lack of females.

Future translocations of female buffalo are planned in order to improve the sex ratio of the Chhattisgarh population, and enable a successful breeding programme to be established. This is an exciting project which could hugely benefit the populations of wild buffalo in Chhattisgarh!

Photograph obtained from the original article by Deepanwita Gita Niyogi (http://tehelka.com/chhattisgarh-hopes-to-turn-around-its-wild-buffalo-population/)

Banteng Conservation in Cambodia: making progress

Nick Marx, Director of Wildlife Rescue and Care Programes at Wildlife Alliance, works to conserve banteng in Prambei Mom in Cambodia. In the last issue of BULLetin, we described their work rescuing banteng caught in traps for the wildlife trade. Here, Nick shares an update of Wildlife Alliance's activities to support the patrols and community conservation in Prambei Mom.

By Nick Marx

Since our initial involvement to protect the population of banteng, *Bos javanicus,* in Prambei Mom, Kampong Speu province, Cambodia, which started in 2018, there have been significant steps forwards, which gives us hope that these animals now stand a chance of survival.

To recap, in 2018 we heard about a community who, despite their own lack of resources, were determined to conserve the remaining banteng living in the foothills below Aural Wildlife Sanctuary. Animals were being snared and during one visit by Wildlife Alliance staff to capture and treat a snared banteng, rifle shots were heard. A Wildlife Alliance forest protection team apprehended one of the hunters, a Military Police officer, as he cut up the dead bull banteng. The MP was prosecuted and sentenced to a prison term.

Wildlife Alliance is now providing equipment and a small amount of money to the community on a monthly basis and we are researching the area to determine the number of banteng here and improve the prospects for their survival. The dry-dipterocarp forest gets extremely dry during the dry season and we have constructed pools to ensure the banteng and other wildlife has water throughout the year.

The community surrounds the dead banteng

Due to the surrounding publicity the government authority in charge of the area, Forestry Administration (FA) is now also showing an interest and giving support. At the beginning of 2020, FA provided a fire truck to help extinguish the frequent fires that take place during the dry season. An official building is also now being constructed by FA, which will provide a formal base for the community rangers and FA officials to operate from, which should help improve protection.

Wildlife Alliance has purchased camera traps to help assess the number and condition of the banteng in Prambei Mom. We have photographs of at least 5 calves or young banteng, indicating that there is successful regeneration now taking place. There have been no further shooting incidents since the apprehension of the MP and thanks to the improved patrols implemented by the community rangers, there are fewer incidents of snared banteng now.

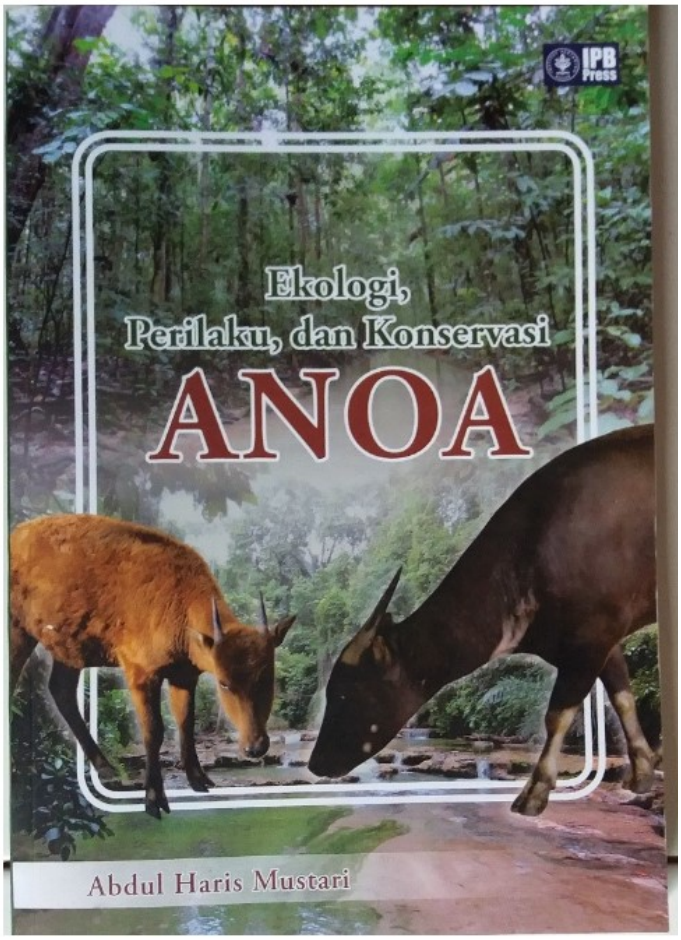
Encouraged by the success of this project to support local communities to protect their own wildlife, Wildlife Alliance has identified other areas in which banteng continue to survive, which are not receiving sufficient recognition or protection. We intend to support these sites also, with improved protection and resources.

Find out more about the Wildlife Alliance's work in Prambei Mom and how you can get involved:https://www.wildlifealliance.org/banteng-

Group of banteng captured on a camera trap having a drink

Book Release: Ecology, Behaviour, and Conservation of Anoa, by Abdul Haris Mustari

By Abdul Haris Mustari, Department of Forest Resources Conservation and Ecoturism, Bogor Agricultural University



In December 2019, a new Indonesian language book was published on the ecology, behaviour and conservation of anoa, written by Abdul Haris Mustari and sponsored by The Indonesian Ministry of Environment and Forestry, Enhancing Protected Area System in Sulawesi (EPASS) for Biodiversity Conservation and Wildlife Conservation Society-IP. This comphrehensive anoa text book is based on a long-term field study of the species in the natural habitat during the last 25 years.

It covers many aspects of ecology, behaviour and conservation of anoa including: the role of anoa in biodiversity conservation and its evolution and palaeo-ecology; taxonomy, morphology, and anoa among of the living world buffaloes; their population and distribution on the island of Sulawesi, as well as preferred habitat, feeding ecology and behaviour in the wild and in captivity. In the second half of the book, the cultural significance of the anoa is described, as well as methodology for studying populations of anoa and approaches and considerations for anoa conservation.

The full text ebook is available for free download on research gate:

https://www.researchgate.net/publication/339788077_Ekologi_Perilaku_dan_Konservasi_Anoa_Ecology_Behaviour_and_Conservation_of_Anoa

Art for Asian Wild Cattle

This year, artist Marcus Burkhardt offered to use his talents to support the *in situ* work of the AWCSG. He created a gallery of bovid images, and will generously donate 50% of the profits from every sale to support our work in the field. Check out Marcus' gallery and pick your favourite piece, or commission your own on his website: http://natural-and-history-art.de/en/asianwildcattle/. Many thanks to Marcus for his contribution.

RESEARCH

Preliminary study on the basic ecology and conservation of Banteng *(Bos javanicus*) in a land concession of eastern Cambodia

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Keywords: awareness raising; ecology; economic land concession; Kratie; patrol

Abstract

Banteng (*Bos javanicus*) is a globally Endangered bovid with its largest remaining natural population surviving in Cambodia. Economic Land Concessions (ELC) in Cambodia is considered a key driver for forest and biodiversity loss in this megafauna-rich country. An innovative conservation project has been running in an ELC in the Eastern Plains Landscape since 2017, with the objective to demonstrate an example of a win-win partnership of agroindustry developers and conservation organizations in these imperiled forests. The presence of a breeding banteng population has been confirmed during a biodiversity survey, with multiple camera trap photographs of herds with calves. Banteng observed in the study were mainly nocturnally active, with some crepuscular activities, and can be detected in roughly equal frequency in both deciduous dipterocarp and semi-evergreen forests. Mean banteng group size was 1.9 (range 1–8; median 1) based on our limited data due to camera loss caused by theft and vandalism. Our study presents basic ecology data of the mainland banteng in an unprotected landscape, providing preliminary insights into their behavioural adaptability to disturbed habitats. The site is facing imminent threats currently widespread throughout Cambodia, such as illegal logging, poaching, and mining. To tackle these problems and instigate conservation awareness among the local human population, a forest patrol team consists of community rangers led by a Khmer young conservationist has been established, and their daily patrol is proving to be a useful deterrent to forest crimes. Some awareness raising activities were also organised targeting the ELC workers and local communities.

Introduction

All Asian wild cattle are threatened due to rampant hunting and habitat loss (IUCN-SSC Asian Wild Cattle Specialist Group 2010). Banteng (*Bos javanicus*) is an Asian wild cattle once widely distributed across mainland southeast Asia and the Sundaland islands of Borneo and Java, but populations have experienced dramatic declines throughout its natural range, and the species is currently categorized as Endangered by the IUCN Red List, with an estimated global population of 4,000–8,000 heads (Gardener et al. 2016). Cambodia is home to the largest banteng population within its native range, which is concentrated in the Eastern Plains Landscape east of the Mekong, reputedly supporting > 50% of the world's remaining animals (Gray et al. 2012, 2016). Cambodia has one of the fastest rates of forest loss in the world, even within protected areas (Hansen et al. 2013). The government scheme of Economic Land Concession (ELC) provides long-terms land leases for domestic and foreign investors to develop industrial-scale agriculture, many of which carved out from or abutting protected areas and currently accounts for over 12% of total land area of the country. ELC is therefore considered one of the major drivers for forest and biodiversity loss in Cambodia (Gray et al 2012, Beauchamp et al. 2018).

In 2017, Kadoorie Farm and Botanic Garden (KFBG), a Hong Kong-based conservation NGO, was invited by the Chinese Government of Agriculture to launch a conservation project at Green Island Agricultural Development (Cambodia) Limited (hereinafter Green Island), a Chinese-owned ELC granted for agricultural development, with the hope to develop a demonstration site where agroindustry and biodiversity conservation can coexist. The plan has been endorsed by and gained full support from the central government bodies responsible for agriculture in both countries. KFBG's role in the collaboration is to implement biodiversity conservation projects and provide recommendations on sustainable agriculture practices.

As Green Island and its surrounding forests have never been surveyed, a series of biodiversity surveys, including camera-trapping, were conducted over the past three years. Our survey yielded some exciting results such as records of the Critically Endangered yellow-breasted bunting (*Emberiza aureola*) and elongated tortoise (*Indotestudo elongate*), the globally Endangered banteng (*Bos javanicus*), black-shanked douc (Pygathrix nigripes) and green peafowl (Pavo muticus), and two bunting species of particular ornithological interests: little bunting (*Emberiza pusilla*) - first record for Cambodia, and black-headed bunting (E. *melanocephala*) - first field record for Cambodia (Chan & Li 2017). Full results of our biodiversity survey will be published elsewhere in due course. Our field results demonstrate that this ELC supports significant conservation value on par with the country's national parks (KFBG, unpublished data). Green Island, however, is suffering from the same forest crimes currently widespread throughout Cambodia, with rampant logging and poaching happening round the clock Our camera-trapping survey recorded the banteng on many occasions, allowing us to report some preliminary observations on the basic ecology of banteng at this highly disturbed site. Some of our ongoing conservation activities to tackle the rampant logging/hunting issues are also presented.

Although it is well-known that banteng show adaptability and some resilience to disturbed habitat, and larger herds are found congregating along abandoned logging roads (Journeaux et al. 2018), little is known about the effects of logging on their ecology (Prosser et al. 2016), and little information is available for populations living in unprotected areas, particularly for the mainland banteng *B. j. birmanicus* (IUCN-SSC Asian Wild Cattle Specialist Group 2010; Gray et al. 2016). Recent studies showed that Bornean bantengs, B. *j. lowi,* regulated their diel activity, foraging behaviour and diet in respond to logging and forest regeneration (Gardner et al. 2018, 2019); furthermore, they showed a reduction on body conditions in conventionally logged forests compared to reduced-impact logging forests (Prosser et al. 2016). In this study, based on a limited set of camera trap data, we provide a glimpse into the ecology and adaptability of mainland banteng in the highly disturbed and unprotected forest in a land concession.

Study site and methods

Green Island is located in Sambour district of Kratie Province, eastern Cambodia (12°47'--12°51'N, 106° 13'--106°23'E, altitude range: 70–230 m). The total area of Green Island, leased for 50 years starting from 2006, is about 130 km2, and the management of Green Island has agreed to allocate 80 km2 (~61.5% of the ELC) as a private protected area. Natural vegetation currently covers ~70% of Green Island, which is a mosaic of deciduous dipterocarp forest (DDF), mixed deciduous forest (MDF) along watercourses and dense semi-evergreen forest (SEF) on elevated grounds (Fig. 1). It is worth noting that this vegetation mosaic is shown to be the preferred habitat of banteng in the country (Phan & Gray 2010). Green Island is within the Eastern Plains Landscape, situated close to the provincial boundary with Mondulkiri adjacent to the megafauna-rich Phnom Prich Wildlife Sanctuary, thus connecting this ELC to other important wild cattle populations in Mondulkiri Province. Our camera trap survey started in January 2017. A total of 65 camera traps (Loreda L710, YIANWS-LOREDA R&D CENTER, Qingdao City, China) were deployed in microhabitats thought to likely maximize the probability of detecting medium- to large-sized ground dwelling mammals, such as animal trails, water sources, and underneath fruiting trees.

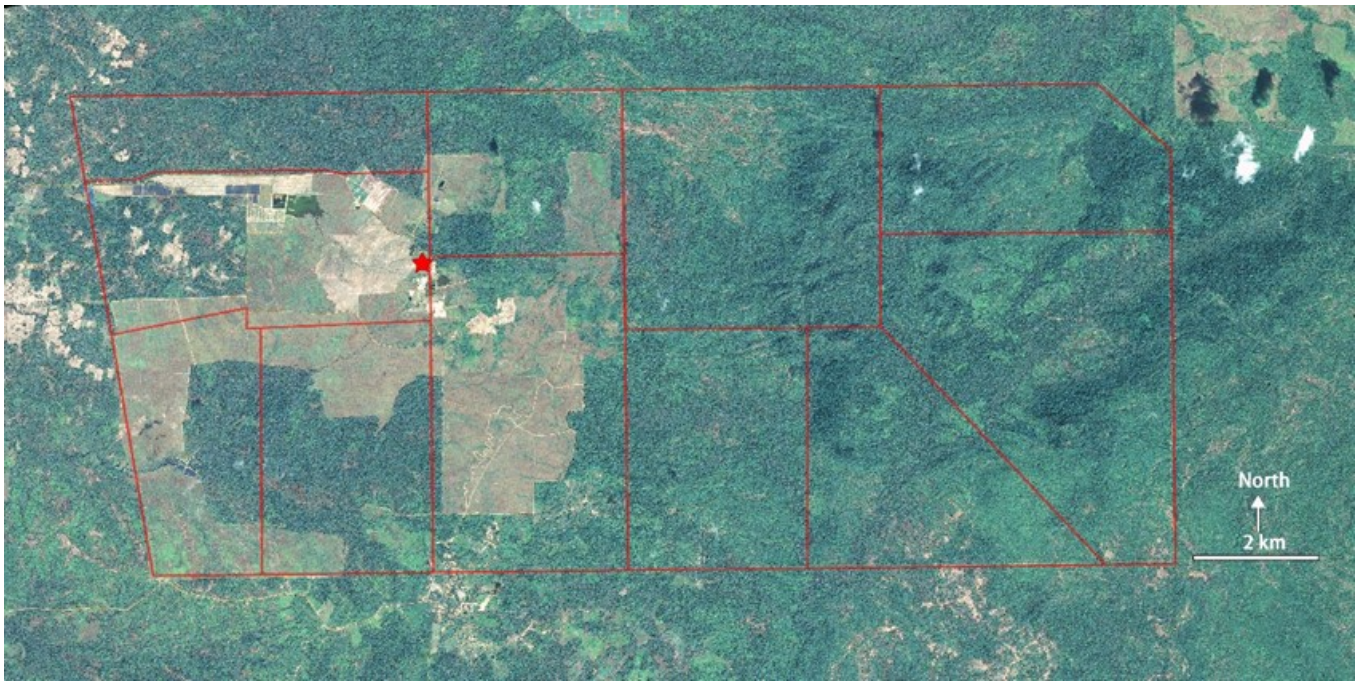

Fig. 1 The study site, Green Island in eastern Cambodia, is still largely under natural forest cover. The outer red box is boundary of the ELC; the inner red lines are borders of different 'land lots' assigned by the Cambodian Government. Red star indicates the location of the headquarters.

We defined a camera trap record as a notionally independent record if it occurred 30 minutes or more after an image of the same species at the same station. One trap-night was defined as a continuous 24-hour period of camera operation. Due to the extremely high intrusion rate of loggers and poachers, camera trap units were constantly stolen or destroyed, with only four to six camera trap units remaining operational from January 2018 until the end of December 2019, which severely limits our ability to collect representative data for two-thirds of the three year study period. To understand the basic ecology of banteng in an ELC with frequent and severe human disturbances, we compared our camera trap data with that of Phan & Gray (2010) collected from two of Cambodia's key protected areas in the Eastern Plains Landscape, and followed their data analysis approaches on group size estimation and activity pattern analysis.

Results

With our limited camera trap data, banteng were recorded by 14 camera trap units (21.5%) over 6515 trap-nights between January 2017 and December 2019, which produced 31 independent records of banteng. This forest bovid was camera trapped in the two major vegetation types of the site: seven units in DDF and seven units in SEF. Of the 31 independent banteng records, 17 (55%) were from DDF and 14 (45%) were from SEF.

The banteng in Green Island was predominantly nocturnal with some crepuscular activities; 90% of records were between 1800–0600 and the peak was in the early morning between 0300–0700; there were no records between 0900–1700 (Fig. 2). Our data suggested banteng activities were the highest between March–May (94%), and calves were only photographed during this season (n=5). However, the observed trends could be an artefact of biased sampling effort since 50% of total trap-nights are in March–May due to the colossal loss of camera traps. Based on our very limited dataset, banteng herd size in Green Island was between one and eight (median = 1; mean = 1.9 ± SEM 0.3); the biggest herd of eight heads included two calves (Fig. 3). Mean banteng group size in Green Island was 1.9, and 61% of our camera trap records were of single individual (Fig. 4). Our preliminary results on habitat preference and diel activity pattern, and to a certain degree group size, are broadly similar with that reported by Phan & Gray (2010).

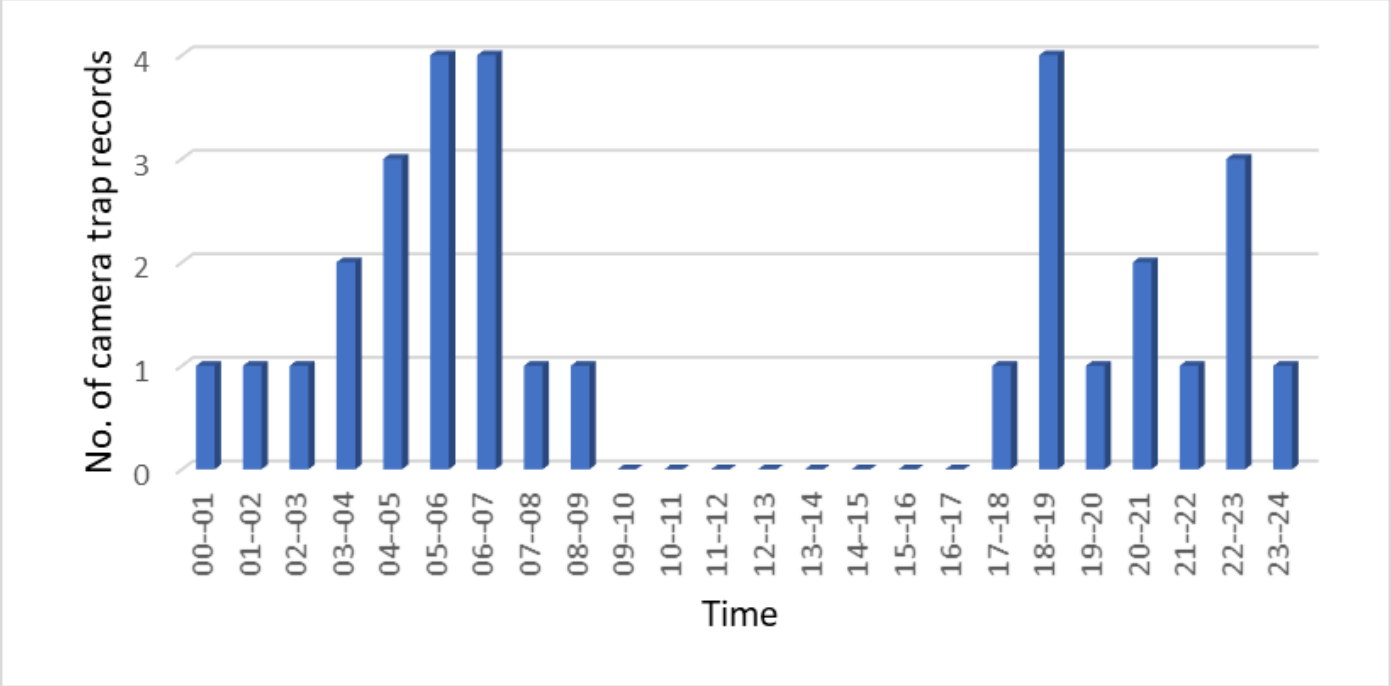

Fig. 2 Diel activity pattern of banteng, based on total number of camera trap records between April 2017 to May 2019, from Green Island, eastern Cambodia.

Threats

With around 300 agroindustry workers and their families living inside Green Island and six communes of >1400 households adjoining the western and southern boundary of the ELC, the forest and its biodiversity are facing imminent threats such as illegal logging, poaching, and mining, as happening elsewhere in Cambodia including protected areas. Chainsaw sound were a continuous background noise during patrol and fieldwork; gunshots were occasionally heard; snares, electrocute hunting wires and mist nets were regularly found; banteng with snare injuries were photographed (Fig. 5). A mining company, with their own permits issued by respective government departments, started gold prospecting in a corner of the forest. While some of these threats, such as gold prospecting, might take government interventions such as policy reform to resolve, we are actively tackling the problems of logging and hunting.

Conservation interventions

Protection

As hunting and habitat loss are the greatest threats to Asian wild cattle (IUCN-SSC Asian Wild Cattle Specialist Group 2010), KFBG have been funding Green Island to establish a forest patrol team since June 2019 to tackle the rampant logging/hunting issues. A small team of seven community rangers, all former loggers/hunters from the surrounding villages, were recruited and is being led by a Khmer conservation officer. We delivered training on biodiversity and conservation to the team members, equipped them with essential field tools including motorbikes and, to instill a sense of pride in their banteng conservation work, the team was named “Banteng Forest Patrol Team” with a team logo designed and printed on their uniform (Fig. 6). The team carried out daily patrol throughout the ELC, some at night with armed police and on a few occasions with enforcement officers of the Cambodian Ministry of Agriculture, Forestry and Fisheries. Their daily patrol is proving to be a useful deterrent to forest crimes – since patrol began last June the team detected and expelled 327 illegal loggers/poachers; destroyed/confiscated 13 hunting rifles, 529 snares/traps, 50 fishing nets, 30 mist nets and 1150 meters of electrocute hunting wire. In addition one small Indian civet (*Viverricula indica*), one long-tailed macaque (*Macaca fascicularis*), four Asian woollyneck (*Ciconia episcopus*), three red junglefowls (*Gallus gallus*) and one Burmese python (*Python bivittatus*) were rescued from traps, and were either released if unharmed, or sent to the Phnom Tamao Wildlife Rescue Centre in Takeo Province.

Awareness raising campaign

During a rapid participatory rural appraisal conducted at the onset of our project, logging is considered by a large proportion of the local communities as a major income source, and hunting is also widely practiced by both villagers and the workers. To instigate conservation awareness among the local human population, some awareness raising activities have been organised, targeting the 300 local workers employed by Green Island and their families. These include a mural painting activity at the workers' quarters depicting key biodiversity features of the site, as well as conservation talk to all workers and their families . We are planning to expand our educational work to the surrounding communes soon with the help of our local rangers.

Fig.3 A herd of banteng with calves camera-trapped in Green Island, eastern Cambodia. Photographed on 8 April 2017.

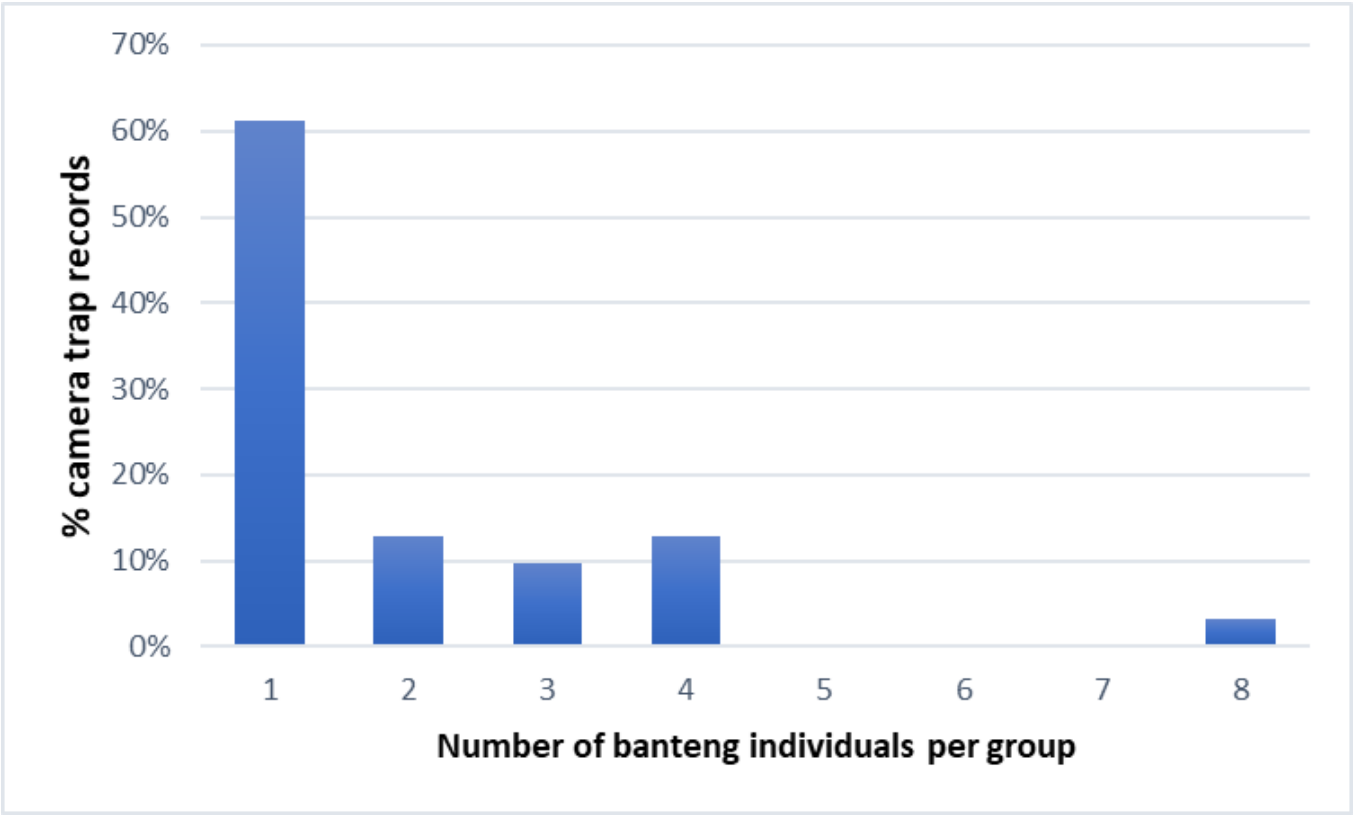

Fig. 5 Number of banteng individuals per camera trap records from Green Island, eastern Cambodia.

Fig. 5 A male banteng with a snare injury (red circle) photographed in Green Island, eastern Cambodia. Photographed on 8 April 2017.

Discussion

Our survey confirmed the banteng and a suite of other globally threatened wildlife still occur in Green Island, an economic land concession suffering heavy human disturbances, and breeding of banteng is confirmed by presence of calves. The ecology of mainland banteng in mainland Southeast Asia is extremely poorly known (Phat & Gray 2010), and the available information is mainly collected in protected areas (Gray et al. 2016). Our study, although limited in sampling size, presents one of the few scientifically collected natural history data in unprotected landscape. Our data suggest the basic ecology of banteng in Green Island and various key protected areas in the Eastern Plains Landscape appear similar, despite the polarised statutory land use status. The group size observed in Green Island was slightly smaller than that of Phan & Gray (2010). Single banteng was recorded in 54% of camera trap photographs in Phan & Gray (2010), while 61% of our camera trap records were of single individuals. However, it is worth noting that the accuracy of using camera trap photographs for estimating group size is questionable (Phan & Gray 2010). For example, a herd of eight banteng including two juveniles was captured by one of our camera traps (coded unit-S13) in DDF on 8 April 2017; one day later, a camera trap in SEF (unit-N14), 980 m away from unit-S13, captured a female with two juveniles. Using the natural marks of the female and the body and horn sizes of the two juveniles, we could confirm these two camera traps recorded the same female and the two juveniles, which means at least five animals of the same herd were not detected by camera trap unit-N14 inside the dense SEF. Therefore, using the number of individuals in photos/videos captured by camera traps has a high probability of underestimating banteng group size especially in dense forest. However, due to the limited camera trap data obtained, we were unable to estimate the banteng population size in Green Island. Forest users interviewed in Green Island regularly reported larger herds, with group of over 20 reported on more than one occasions; and they also reported the presence of Gaur (*Bos gaurus*) in the semi-evergreen forests of Green Island. Given that the estimated banteng density in the eastern plains landscape of Cambodia was 0.94 ± SE 0.14 individuals/km^2 in Gray et al. (2012), a population of 86 animals is therefore estimated to be living in the 91 km^2 of natural forest in Green Island. We plan to conduct a systematic survey on the population density and ecology of wild cattle in Green Island once the illegal logging and hunting activities are effectively controlled.

Fig. 6 Part of the 'Banteng Forest Patrol Team' employed by Green Island. Photographed on 3 October 2019.

Banteng in Green Island were mainly nocturnal but also showed crepuscular activity, spending more time on foraging and social activities from dusk until the early morning. However, we cannot ascertain if this is an ecological adaptability to reduce activity during hot sunny midday in logged open forest as reported in Bornean banteng (Gardner et al. 2018), or it is an avoidance response to heavy anthropogenic pressures (Phan & Gray, 2010).

It was reported that logging may bring short-term positive benefits for banteng by creating lush undergrowth as an ideal foraging conditions, and the extensive network of logging roads facilitates travel of Bornean banteng (Gardner et al. 2018, 2019). However, as pointed out in Gardner et al (2019), the impacts logging and ensuing poaching caused to the banteng may counteract any positive benefits. It is to be studied if similar patterns apply to the mainland banteng in Cambodia.

Logging and forest regeneration will create environmental conditions that are favourable for exotic invasive plant species in tropical Southeast Asia (Padmanaba & Sheil, 2014), and the herbivorous banteng may serve an important role in minimising the proliferation of invasive exotic plants, and benefit the regrowth of native timber species (Gardner et al. 2019), which further highlights the importance of conserving banteng in commercial forests like Green Island. However, preserving patches of dense mature forest is essential within land concessions, since banteng will use closed-canopy forest to take refuge from disturbances and to minimise exposure to high temperatures (Gardner et al. 2018)

The change in attitude and behaviours of local people are the key for safeguarding the future of tropical forest and wildlife (Ploeg et al. 2011). Members of the forest patrol team are all from the surrounding local community, therefore their change to pro-conservation attitudes and behaviours would hopefully set examples in their respective villages (Steinmetz et al. 2014). With the endorsement of the ELC company to conduct conservation work in their land, KFBG is funding all conservation activities in Green Island; including all costs of the forest patrol team, field survey and environmental outreach, which is proven to be effective and essential if the biodiversity of these forests are to be saved. It therefore appears to be beneficial for more conservation NGOs and funding agencies to look beyond protected areas and engage land concession and community forest owners in innovative partnerships to preserve the integrity of the forest landscape of Cambodia. We hope our project can demonstrate the feasibility and importance of implementing conservation work in ELCs, so that the remarkable biodiversity of these unprotected and imperiled forests can be salvaged.

Acknowledgements

The authors would like to thank our partners at Green Island Agricultural Development (Cambodia) Limited for their understanding, support and collaboration, especially their Chairman Mr. Minghua HE for his foresight in embracing biodiversity conservation as a sustainable business model to develop agroindustry. We acknowledge the Ministry of Agriculture, Forestry and Fisheries, Kingdom of Cambodia for support of our innovative conservation project in an economic land concession with endorsement from H.E. Mr. Veng Sakhon, Minister of Ministry of Agriculture, Forestry and Fisheries. The Forestry Administration of the Ministry of Agriculture, Forestry and Fisheries kindly participated in joint patrols and gave guidance. A special thanks to Von Saran, Nhil Sophan, Phat Vong, Phon Sothon, Moa Sokhim, Chang Chorn and Srae Sokhum, members of the Banteng Forest Patrol Team, for their hard work and dedication in protecting the forest and wildlife of Green Island.

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Members of the Team South during the survey (F. García)

Dung hunting: an alternative method of monitoring tamaraw abundance in Mts. Iglit-Baco Natural Park

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Introduction

Mts. Iglit-Baco Natural Park (MIBNP) is the largest protected area on Mindoro Island of the Philippines, covering 106,655ha. It supports the largest population of the Critically Endangered tamaraw (*Bubalus mindorensis*), a species endemic to the island (Ishihara et al., 2014, Ishihara *et al*, 2016, Long et al., 2018, Department of Environment and Natural Resources, 2020). Collaboration between the Park Office, local stakeholders and local and international partners has led to finalize and develop the "Protected Area Management Plan' (PAMP) for the next 10 years, almost 40 years after this Protected Area was established. These guidelines set out the actions to be taken in order to manage and develop the park, including the 'Conservation of species, habitats and ecosystems' (Program 1).

One sub-programme laid out in the PAMP is tamaraw conservation. A 'Core Zone of Monitoring' (CZM) of 2500 ha, where the majority of the park's tamaraw population resides, provides a vital refuge for the species. Annual surveys of tamaraw numbers in the CZM have been conducted since 2000 using the point count method, a proxy of tamaraw population size (Ishihara et al., 2014, Long et al., 2018)., which does not account for imperfect detection of animals in time and space. Though easy to implement, this technique requires in practice high visibility in order to detect the animals, so areas of grassland are burnt each year by the park's authorities to open the landscape and increase visibility

around the 18 'vantage points' (Ishihara et al., 2014, Long et al., 2018). One of the objectives of the PAMP is to halt the use of burning in the CZM of MIBNP in the years to come in order to allow for restoration of natural vegetation. With restoration, however, detectability of tamaraws will decrease dramatically, as will the relevance of the point count method to monitor its abundance. Therefore, an alternative method is necessary to enable the continuation of this monitoring.

Over the last century, a number of different methodologies have been developed to assess the relative abundance of species (Seber 1982; Schwarz and Seber 1999). One reference method is the distance sampling (Buckland et al. 2004), applied either on direct observation of animals, or indirectly on presence indices (*e.g.* animal droppings). In the distance sampling method, the detection probability of animals derives from the perpendicular distribution of distance of animals or feces along pre-defined transects. A major assumption of the distance sampling method is that no animals or indices are missed on the transect. This assumption is however often not met in hard terrain or densely vegetated habitats such as cogon grassland in MIBNP. This assumption can be relaxed and accounted for by combining the double observer with the distance sampling method of faeces. This combination of information is often used to study populations in areas of low visibility (Jenkins & Manly, 2008).

This pilot study explores for the first time the use of these methods to assess relative abundance of tamaraws, along with the Vulnerable Philippine brown deer (*Rusa marianna*) and the Vulnerable Oliver's warty pig (*Sus oliveri*), in MIBNP. We first wanted to assess the feasibility of implementation of the combined double observer / distance sampling methods at MIBNP, and to obtain a conversion factor between feces and tamaraw densities to allow for comparison between the long-term abundance time series based on point counts, and the envisioned monitoring method based on feces abundance. The project is part of a collaboration between the D'ABOVILLE Foundation and Demo Farm Inc (DAF), the Laboratoire de Biométrie et Biologie Évolutive (LBBE) (France), and the Philippine Department of Environment and Environment Resources (DENR), represented by the Tamaraw Conservation Program (TCP) and the Protected Area Management Office (PAMO) for MIBNP.

Methods

Distance sampling

Distance sampling is well-practiced in the study of ungulate density (Ellis *et al.* 2005; Valente *et al.* 2014; Kumar *et al.* 2017), and because this methodology can be adapted to use indirect signs, such as dungs, it is suitable in environments where detectability of animals is low (Jenkins and Manly, 2008). In this study we use dungs as an indirect sign of each of the three focal species. The observers record all dungs detected from along a fixed-length transect, along with the perpendicular distance from it. After carrying out three 'test missions', to establish a final methodology for the preliminary study and to build capacity through training of PAMO and TCP staff, a transect length of 500 meters was selected. number of intended replication.

Double observer method

Though valuable, distance sampling of faeces is subject to observer bias, with observers able to miss samples, thus resulting to an unknown underestimation of dung density. Employing a double observer on the top of the distance sampling

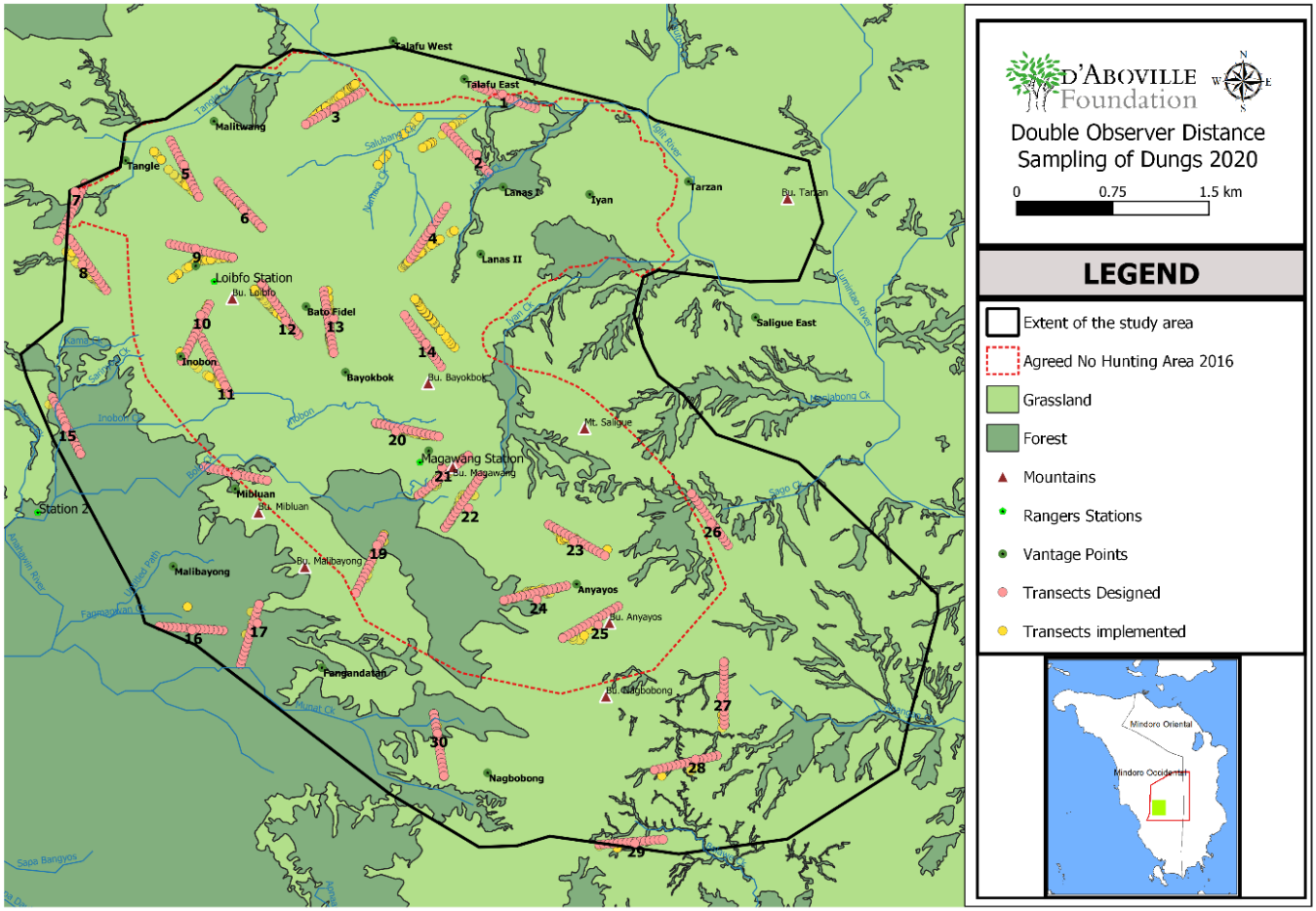

Figure 1 Designed (pink) and implemented (yellow) transects from the Double Observer Distance Sampling of dungs study of 2020 in the Core Zone of Monitoring of Mt. Iglit-Baco Natural Park.

allows to relax the assumption of perfect detection on the transect and correct the estimation (Nichols et al. 2000; Jenkins and Manly, 2008). The two approaches to the double observer method, dependent and independent, were both trialed in the test missions. The dependent approach involves both sets of observers taking recordings along a transect simultaneously, with the second observer only recording samples that were missed by the first. The independent design requires full recordings to be taken by both observers, with no contact between parties permitted to ensure no awareness of the other's observations. In the end, the dependent double observer method was favored and selected for this study because it was easier to implement in the field.

Pilot study

Pilot data was collected from the study site in the CZM from 3-10 February 2020. 30 transects were planned (T1-T30), with only one omitted (T26) due to the topography of its location (Figure 1). Two transects (T1 and T2) were moved at the request of representatives from residing indigenous communities. Two teams - North (covering T1-T15 North of Magawang ranger's station) and South (covering T16-T29 to the South) - each comprised 11 members, including one Indigenous People (IP) representative. Two members of the team would be responsible for opening the path for sub-team 1 (two members) to carry out the first set of observations. Two more members would record the observations of sub-team 1, noting the number, species, perpendicular distance from the transect, the habitat type (grassland or forest), and estimated age of the faeces. Sub-team 2 would then follow behind the group and indicate to the recorders data missed by sub-team 1. The final two members did not participate in the data collection, but were responsible for the

Table 1 Number of dungs per transect (with transect 26 removed from the list) during the Final Pilot Study of Double Observer Distance Sampling of Dungs in MIBNP in February 2020.

Transect	Tamaraw	Philippine brown deer	Oliver's warty pig
1	9	1	2
2	16	4	1
3	31	12	7
4	31	5	7
5	26	4	4
6	42	10	6
7	0	0	0
8	27	0	0
9	45	9	3
10	25	3	0
11	13	0	3
12	53	2	3
13	31	10	2
14	47	26	0
15	1	0	0
16	0	0	0
17	0	0	0
18	0	0	0
19	18	0	0
20	83	3	4
21	99	2	3
22	133	4	2
23	25	14	0
24	73	5	3
25	13	1	0
27	2	4	0
28	6	1	0
29	1	1	4
30	0	1	1
Average	32.4	2.6	1.2

transportation of equipment and provided assistance at field camps.

The following equipment was carried by each team: 1 GPS (Garmin eTrex 10 for North and GPSmap 60CSx for South), 1 set of spare rechargeable batteries and battery charger pack (Panasonic Eneloop), 1 compass, data sheets, notebook and pens, lamps and tarps. All equipment was provided by D'Aboville Foundation (DAF).

Communication and collaboration with communities residing within the study area was maintained as a key element of this operation.

Results

Over the course of this study, 14,607m of transects were covered (7,615m in the North, 6,992m in the South). A total of 850 tamaraw dungs were recorded, plus 122 of Philippine brown deer and 55 of Oliver's warty pig. The number of dungs recorded along each transect are shown in Table 1.

The use of the double observer method resulted in the significant recording of initially missed dung samples. For tamaraw, an average increase in the number of dungs recorded was 19.9% (ranging from 0-46% for each transect). There was a greater discrepancy in the number of Philippine brown deer and Oliver's warty pig dungs recorded, with around 43% of dungs initially missed by sub-team 1 and later observed by sub-team 2.

Results showed that the difference in recordings from sub-team 1 to sub-team 2 varied between the North and South teams. Front team in the North (sub-team 1N) recorded an average of 67.75% of the total dungs (of all three species) along each transects, whereas the front team in the south (sub-team 1S) recorded 84.78% of the total.

Areas with higher density of tamaraw dungs were similar to areas with higher direct observation during the point count 2019. Thus, results of both monitoring methods are converging in terms of distribution pattern of the species within the CMZ. In addition, the general spatial structure of the tamaraw population following a trend of decreasing density from the center of the CZM to its periphery is visible in both operations, sustaining that it is not a bias of the methods.

Discussion

This final pilot study for Double Observer combined to Distance Sampling has enabled the recording of useful biological information in addition to the estimate of dung density. It provides some new information about tamaraw distribution, its interaction with the two other large herbivore species, as well as a better overview of the status of Philippine deer and Oliver´s warty pig within the CZM of MIBNP. Tamaraw dungs were observed in clusters of higher concentrations, particularly in the areas where patrolling is regular, which indicates a clear spatial structure of distribution and the positive role of the presence of rangers on the population dynamic of the species

It moreover demonstrates the importance of the double observer method in producing more reliable results. Such technique can help solve the problematic assumptions of traditional distance sampling, avoiding observer bias and observer inaccuracy, and allows us to collect a larger data set using affordable and repeatable methods. The study has highlighted further improvements and modifications of the field protocol and implementation that will be necessary before it is used routinely in the future. For instance, there is a substantial topographic difference between the North and the South parts of the monitoring area, with the South being more mountainous and uneven in terrain. The overall landscape is mountainous and physically challenging, with ecological characteristics that must be taken into account in the future and final design of transects to make it usable and useful in the long run.

However, whilst distance sampling can enable collection of data in areas with lower visibility in any part of the study area, the method provides only an estimate of dung density and not tamaraw abundance. Moreover, important information such as sex ratio and age structure of the population cannot be obtained through indirect signs of presence. A comparison of the data from the point count survey and the distance sampling (Figure 2) will help us to establish a conversion index between the density of animals and the density of dungs. Nonetheless, such monitoring operations using the distance sampling method are practically less intrusive than the point count as used in MIBNP and less expensive, requiring less manpower than the annual count operation.

Next steps

Following this pilot study, all data collected will be more thoroughly analysed to (a) estimate dung density, (b), extract an index of abundance of the tamaraw and (c) determine a detectability rate for correction of the index, while projecting the results into a Bayesian integrated population model (IPM) with the traditional point count method and the double observer point count method.

Results of the distance sampling operation, combined with those of the point count, will provide a more robust and unbiased estimate of the abundance of the tamaraw population in the CZM.

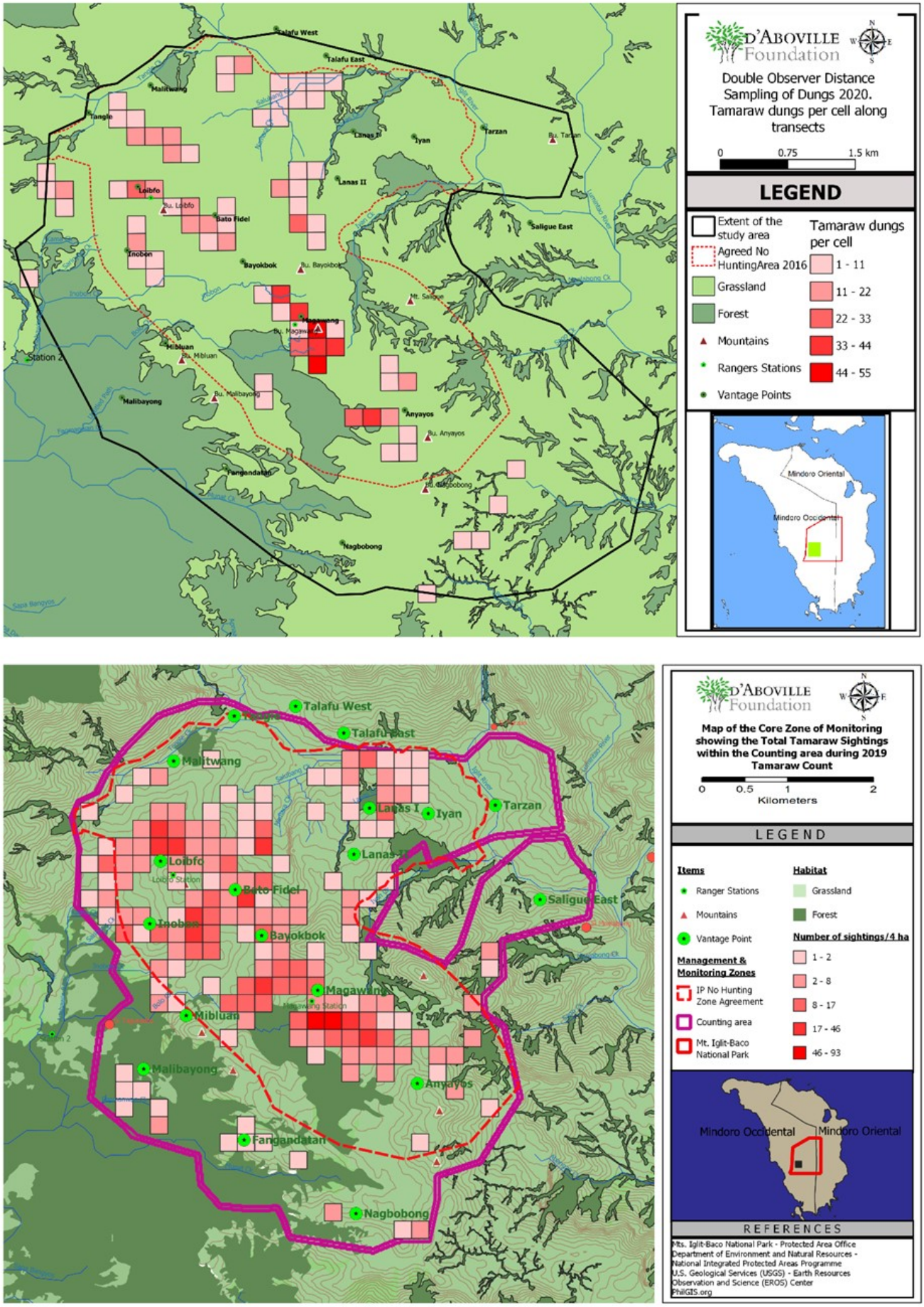

Figure 2. Above: Number of tamaraw dungs found along the transects projected on the grid map of the CZM of MIBNP, showing the relative density of them and spatial distribution pattern **Below:** Map of the Core Zone of Monitoring of MIBNP with the results of the Annual Point Count of tamaraw. We can see represented the density of sightings of the animals per cell. The pattern displayed in the map is similar to the map displaying the results from Double Observer Distance Sampling of Dungs 2020

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AUTHOR GUIDLINES

Aim & Scope

BULLetin is the official, peer-reviewed publication of the IUCN/SSC Asian Wild Cattle Specialist Group. It aims to provide information on all aspects of natural history for the relevant species (Anoa, banteng, gaur, kouprey, saola, tamaraw, water buffalo and yak), with a particular focus on their conservation and management, both *in* and *ex situ*.

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Relevant news and notes from the field that may contain figures and tables (up to 2,500 words)

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Short evaluations of recently published books and monographs of interest to the AWCSG (up to 1,500 words)

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- Results
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- Acknowledgements (optional)
- References (Harvard style)
- Figures and tables, presented alongside individual captions (please also send photos and figures in separate files in the highest available resolution)

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The metric system should be used for all measurements and weights with a space between the number and the unit of measurement. Temperature should be expressed as degrees Celsius (^{o}C). Numbers from one to nine should be spelled out except when used with units; e.g. one anoa but ten banteng and 3 km.

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Please use common English names of plants and animals, and adhere to the taxonomy used in the IUCN Red List. At first mention in the main text, give both the common and scientific names (in italics). If possible, also add the local name of the species in the area where you work.

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