BORNEAN BANTENG ACTION PLAN FOR SABAH

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EXECUTIVE SUMMARY

The goal of this Bornean Banteng Action Plan 2018-2027 is to provide direction and guidance on the strategies, priorities and actions for banteng conservation at the state level for the period 2019-2028 (10 years). The objective of the Action Plan is to promote the safeguarding of sufficient habitat with adequate carrying capacity, the increase of the banteng population by approximately 10% by 2028 and the long-term survival of the four banteng regional management units. This document results from an extensive consultation process initiated during the “Population and Habitat Viability Assessment Workshop” (Kota Kinabalu, 27-29 November 2017) and “International Workshop on Bornean Banteng Conservation in Sabah” (Kota Kinabalu, 30 November-1 December 2017).

Bantengs were estimated to number between 300-500 in 1982 but were thought to have declined to <300 individuals by 1997. Following a state-wide survey between 2011-2016 by DGFC, localized extinctions have occurred in a number of areas where they were once common, owing to land conversion to oil palm plantations. The present-day population size is estimated at a minimum of 326 individuals, but a number of locations (i.e. Kulamba Wildlife Reserve, Kalabakan FR, Imbak Canyon Conservation Area) were not surveyed. Key banteng populations can be broadly classified into four distinct subpopulations or regional management units, representing the north (Paitan-Sugut), east (Kulamba-Tabin), central (Central Forest) and west (Sipitang) of Sabah.

In Sabah, Bornean banteng decline is directly attributed to hunting and indirect snaring, habitat loss (including pastures) and fragmentation leading to a reduction of gene flow, road development (Pan Borneo Highway) and hybridisation with domestic cattle.

The 10-year goals of this BBAP are to identify, develop and implement strategies and actions that will address the threats of the species in all management units that have been identified in Sabah by providing guidance to key players that will implement these strategies.

The main objectives of this BBAP are the following:

1. Increase enforcement by supporting and strengthening Sabah Forestry Department's enforcement team 'Protect' and the 'Forest Ranger' initiative, Sabah Wildlife Department's "Enforcement team' and the 'Honorary Wildlife Warden' initiative, and Sabah Parks' 'Enforcement team' and the 'Park Ranger' initiative.
2. Establish SMART patrols across all Bornean banteng regional management units and standardise the reporting system and the data base (real time monitoring).
3. Ensure that a specific enforcement plan is included in all Sustainable Forest Management Licence Agreements to make sure that patrolling is carried out regularly and there is an annual work plan and a budget to implement the activities.
4. Set up a Bornean banteng captive breeding programme in Sabah.
5. Cryopreserve Bornean banteng gametes.
6. Any area with presence of bantengs must be managed sustainably by developing and maintaining pastures within and near the home ranges of the existing herds.
7. Establish and maintain landscape connectivity throughout the range of the Bornean banteng, and especially within Central Forest management unit, between Tabin and Kulamba Wildlife Reserves and between Paitan and Sugut Forest Reserves.
8. Monitor population changes for the duration of the plan.
9. Carry out a risk assessment of the presence of domestic cattle and potential hybrids within and around protected areas (Kalabakan Forest Reserve, Tabin and Kulamba Wildlife Reserves).
10. Improve awareness about Bornean banteng in the vicinity of protected areas.
11. Set up an Endangered Species Conservation Unit (ESCU) to monitor the implementation of all action plans on totally protected (Schedule 1) terrestrial species in Sabah: banteng, elephant, Malayan sun bear, orangutan, proboscis monkey, Sunda clouded leopard and Sunda pangolin.

TABLE OF CONTENTS

1) **INTRODUCTION** **1**
- 1.1 Origin and taxonomy 1
- 1.2 Legal status and legislation 3
- 1.3 Ecology and behaviour 3
- 1.4 Population genetics 11
- 1.5 Current distribution and population trends 13
- 1.6 Major threats 19

2) REGIONAL MANAGEMENT UNITS **24**
- 2.1 Sipitang 24
- 2.2 Paitan and Sugut 25
- 2.3 Central Forest 27
- 2.4 Tabin and Kulamba 28

3) NON SITE-SPECIFIC PRIORITY ACTIONS **30**

4) SITE-SPECIFIC PRIORITY ACTIONS **38**

5) IMPLEMENTATION, MONITORING, EVALUATION AND BUDGET **47**

6) LIST OF ABBREVIATIONS **49**

7) REFERENCES **50**

SPECIES ACTION PLAN COMMITTEE MEMBERS **52**

1) INTRODUCTION

1.1. Origin and taxonomy

Three subspecies of bantengs (*Bos javanicus*) are widely recognized and this is based on phylogenetic analysis of mitochondrial DNA and inferences of their evolutionary history: the Burma or Burmese banteng (*B. j. birmanicus*) in mainland Southeast Asia, the Java banteng (*B. j. javanicus*) in Java, and the Bornean banteng (*B. j. lowi*) which is endemic to the island of Borneo (Figure 1).

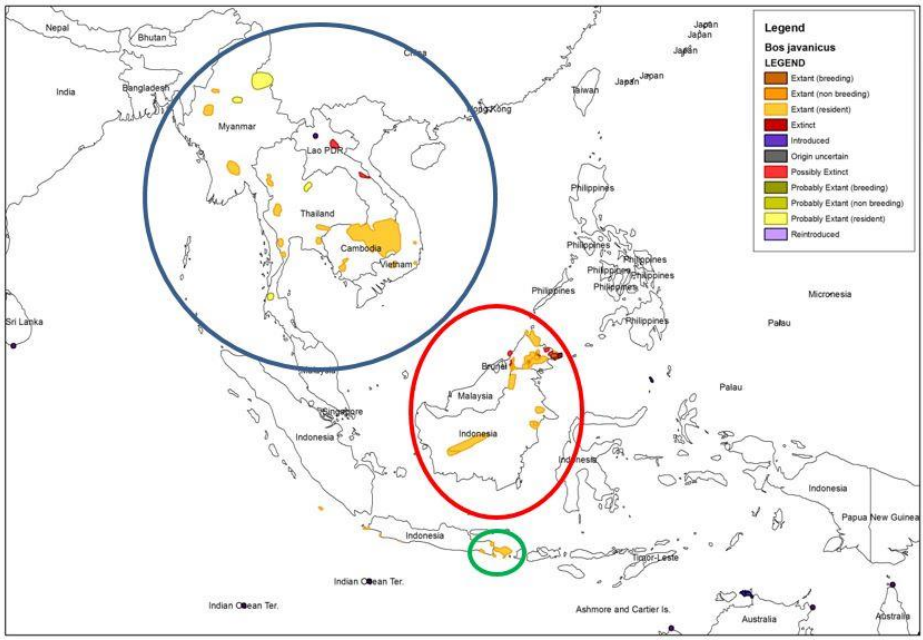

Figure 1. The world-wide distribution of banteng subspecies: Burma or Burmese banteng (*B. j. birmanicus*: blue circle), Java banteng (*B. j. javanicus*: green circle), and the Bornean banteng (*B. j. lowi*; red circle) (Gardner et al. 2016).

The banteng is likely to be a monophyletic species that dispersed across the Sunda shelf (land bridges) connecting the Malayan and Indo-Malayan sub-region during the last glacial period (maximum 22,00-19,000 years ago) (Yokoyama et al. 2000). Prehistoric cave paintings in Kalimantan (Indonesia) that date >10,000 years old depict zoomorphic figures, including one animal which is thought to be the

Bornean banteng (Chazine 2005). Bone fragments of wild cattle, believed to be bantengs, were also found in a cave in Sarawak and were dated to the late-Pleistocene period (Medway 1964), suggesting that the Bornean banteng naturally occurs in Borneo. Phylogenetic reconstruction of bantengs by Matsubayashi et al. (2014), Ishige et al. (2015) and Gardner (2015) indicates that the Bornean banteng is most closely related to the wild Indian bison or gaur (*Bos gaurus*). This evidence amplifies the importance of conserving the Bornean banteng separately to other banteng subspecies. The Bornean banteng is morphologically similar to gaur, having starkly white lower legs or stockings with a muscular compact body, however Bornean banteng are smaller in stature than the gaur, they have white buttocks, and a smaller less-pronounced hump between the shoulders (Gardner 2015). Subtle pelage differences are also evident between the three banteng subspecies: *B. j. javanicus*, *B. j. birmanicus* and *B. j. lowi* (Figure 2).

Figure 2. Photographs of bantengs bulls of the three subspecies with subtle variations in pelage colour and body size: Top left: The Bornean

banteng (*B. j. lowi*) with very dark pelage colouration and a stout compact body size, photographed in Deramakot Forest Reserve in the Malaysian state of Sabah as part of this study (©Bornean Banteng Programme/DGFC). Top right: A banteng bull in Thailand (*B. j. birmanicus*) with a brown pelage and heavy-set facial features (©D. Kohn). Bottom: A herd of Java bantengs (*B. j. javanicus*) photographed on the Indonesian island of Java with the bulls evident by their dark brown/black pelage colour. The facial structure of the Java bantengs shows subtle differences in their elongated facial structure (©S. Pudyatmoko).

1.2. Legal status and legislation

In accordance with the International Union for Conservation of Nature and Natural Resources (IUCN) Red List of threatened species, the banteng is classified as 'Endangered' due to their collective small population size and declining trend across their distribution (Gardner et al. 2016). Under the Sabah Wildlife Conservation Enactment 1997, the banteng is listed in Schedule 1 as 'Totally Protected' therefore no hunting is permitted. The possession of a live wild banteng, or of banteng meat or body parts carries a penalty of 50,000RM or imprisonment for five years, or both. Despite repeated evidence of banteng hunting (carcasses, police report, photographic evidence, and first account accounts by government staff) as recently as November 2017, no convictions have been made to-date.

1.3. Ecology and behaviour

1.3.1. Behaviour and activity patterns

Bantengs are shy and cryptic in habit, making them difficult to detect in the forest, and seldom seen directly. They are negatively affected by logging activity, retreating to undisturbed forest and sometimes pushed into higher elevations (e.g. Sipitang Forest Reserve), which are left unlogged due to the unfavourable slope (Timmins et al. 2008). Daily vehicle movement induces withdrawal into the forest (P. Gardner pers. obs.), and heavy vehicles induce a nocturnal habit (Payne et al. 1985). Since the completion of Maliau Basin Field Studies Centre, banteng observations along the main access road have declined, and bantengs are no longer directly observed at close range in Belian camp (Figure 3).

Figure 3. Mature banteng bull observed at close range and photographed using a handheld camera at Belian Camp in Maliau Basin Conservation Area in 2005. Nowadays, bantengs are not directly observed in Belian camp, and a lack of evidence (tracks and dung) during a survey conducted in 2012 by DGFC suggests they now avoid this area, probably due to increased human activity. ©Simon Amos.

Bornean bantengs do not exhibit a strong preference for any one diel period (Gardner et al. 2018), however this may be due to the occurrence and disparity in anthropogenic disturbances within each forest that may either suppress natural activity patterns or confound the daylight-activity relationship. It is worth noting that almost all banteng habitat in Sabah has now been logged over. In degraded secondary forest with limited regeneration (~6-17 years of regrowth), bantengs decreased activity after sunrise and during high ambient temperatures. Consequently, they maximized energy intake during the morning and evening by exploiting degraded open areas that were abundant in pioneer forage. In forest with a longer regeneration period (~23 years), bantengs were active throughout the day, but switched from using open degraded areas to a closed canopy when ambient temperatures were high. Dense forest is essential for bantengs in Sabah; it provides shade, which reduces core-body temperatures and

prevents heat-stress, and it also provides refuge from legal and illegal anthropogenic activities (timber harvest and hunting, respectively).

1.3.2. Foraging preferences

Pioneer plants growing along unsealed roads and in open areas are a strong draw for bantengs, and they will emerge to feed when disturbances are minimal and, generally, when temperatures are lower. As an example, in 2012-2013, a small herd of bantengs were recorded on multiple occasions foraging within scrubland that was in close proximity to the Kalabakan-Keningau highway, which was frequently used by vehicles during the day (P. Gardner pers. obs.). Since this time, this road has been sealed with asphalt and it is unknown if the bantengs returned to this site subsequent to the roadworks.

In general, during the early stages of forest regeneration, bantengs graze extensively in secluded open-canopy locations created by timber harvesting machinery, such as abandoned logging roads and old stumping grounds. In these areas the plant diversity was found to be lower, however the abundance of desirable fast-growing pioneer plant species was thought to be greater (Ridge 2014). This availability is highly attractive to the bantengs, and they spend a greater proportion of time foraging in open canopy areas (Ridge 2014).

1.3.3. Body condition

The effects of timber harvesting (in the context of the structural changes to plants, the opening up of the canopy, the soil compaction and creation of road networks, and the prevailing regeneration of the plant community) upon bantengs are evident in their body condition (Figure 4); bantengs occupying recently harvested (RIL) forest have a higher body condition score (greater fat), however these scores decline as the forest regenerates (Prosser et al. 2016).

Figure 4. The post-logging conditions affect banteng body condition. (top) A mature bull in poor condition with little body fat, and (bottom) a different bull of similar age but in good condition with greater fat coverage. ©DGFC/SWD

Banteng occupying conventionally logged forest had lower body condition scores, and there was only a gradual increase in scores over many years of regeneration (Prosser et al. 2016). Aside from malnutrition, bantengs with injuries have been recorded across Sabah (Figure 5), ranging from broken poles/horns, punctures, lacerations, eye damage, possible dislocation, and a banteng with a hoof missing that was almost certainly a consequence of being caught in a snare.

Figure 5. Injuries sustained by banteng across Sabah: (top left) puncture wound, (top right) eye injury or loss of eye, (bottom left) possible dislocation or break in right foreleg, (bottom right) tears in ears. ©DGFC/SWD

1.3.4. Diet

A high diversity of plants (48 species) have been identified at banteng foraging sites within logged forests, including grasses, shrubs, herbs and tree seedlings, however bantengs were only recorded consuming eight species (Figure 6) from five plant families (Gardner et al. n.d.). Namely, Asteraceae family (Mikania cordata*, Chromolaena odorata, Cyperus difformis), Cyperaceae* family *(Fimbristylis littoralis, Scleria sp.), Leguminaseae* family *(Dismodium triflorium), Poaceae* family *(Eleusine indica),* and *Selaginellaceae* family *(Selaginel sp.).* Bantengs

may also forage upon wild fruits such as guava, which can be found in Maliau Basin Conservation Area and Segaliud-Lokan Forest Reserve, and bamboo (Gardner et al. 2014), which was observed within Sipitang Forest Reserve, Paitan Forest Reserve and Tabin Wildlife Reserve (P. Gardner pers. obs.).

Figure 6. Banteng diet consists of various flora, such as (top left-right) *Mikania cordata*, *Chromolaena odorata*, *Cyperus difformis*, (middle left-right) *Fimbristlis littoralis*, *Scleria* spps, *Disodium triflorium*, (bottom left-right) *Eleusine indica*, *Selaginel* spps (Gardner *et al.* n.d.) and a juvenile male banteng foraging in Malua Forest Reserve. Plant images ©S. Ridge. Banteng ©DGFC/SWD

1.3.5. Sodium

Sodium is an additional important component of the bantengs' diet but is naturally low in prevalence within tropical forests. Bantengs are frequent visitors to natural sodium deposits in Sabah (Davies and Payne 1982) including Deramakot Forest Reserve (Matsubayashi et al. 2007), and are known to perform geophagy, which is the ingestion of sodium-rich soil (Phillips n.d.). Bantengs were reported to occur within beach forest in Kulamba Wildlife Sanctuary, where they licked the ground to take-up salt (Timmins et al. 2008). A study of diet supplements in 2015-2016 found that bantengs exploit artificial mineral blocks and loose salt deposits on a regularly basis in Segaliud-Lokan Forest Reserve (Figure 7), but less frequently in Deramakot Forest Reserve and Paitan Forest Reserve (Phillips n.d.). Bantengs were also recorded at the site of an artificial mineral block in Trusan Sugut Forest Reserve by Phillips (n.d.) but were not observed licking the block itself. Bantengs are known to visit both naturally-occurring mineral deposits and artificial loose-salt deposits in Malua Forest Reserve (P. Gardner pers. obs.).

Figure 7. Bantengs visiting an artificial mineral block in Segaliud-Lokan Forest Reserve in 2015 that was established as part of a study comparing diet supplements by Phillips (n.d.). ©DGFC/SWD

1.3.6. Herd demography

From a study of six forest reserves in Sabah, banteng herd sizes were found to range between 1-21 individuals, which differs from 5-40 banteng previously observed in Sabah by Davies and Payne (1982), suggesting a decline in herd size over time (Journeaux et al. 2018). Herd sizes are smaller as the proximity to the forest boundary decreases and also when the banteng population is in decline (Journeaux et al. 2018). Movement across forest boundaries was identified between Malua and Kuamut Forest Reserves, which support large populations, and indicates that substantial and continuous forest patches are important and required for larger herds to form (Journeaux et al. 2018). The composition of herds, when stratified according to the gender of individuals, varied between forests (Table 1); predominate herd compositions were: solitary male in Tabin, mixed in Malua, mixed and solitary male in Maliau, solitary male in Sipitang and Sapulut, and mixed in Kuamut (Journeaux et al. 2018).

Table 1: Percentage encounter rates of herds according to gender and stratified according to forest reserve from a survey conducted in 2014-2015 by Journeaux et al. (2018).

	% Encounter rate of banteng herds					
Sex/Age combination	Tabin Wildlife Reserve	Malua Forest Reserve	Maliau Basin Conservation Area Buffer Zones	Sipitang Forest Reserve	Sapulut Forest Reserve	Kuamut Forest Reserve
All Male	3	4	2	2	0	21
All Female	0	3	5	24	0	4
Mixed	26	48	34	16	22	30
Mixed + Calf	3	18	13	3	28	13
Female + Calf	11	2	2	3	0	1
Solitary Male	51	17	34	37	47	27
Solitary Female	6	8	10	15	3	4

1.4. Population genetics

Tissue samples for molecular analysis are difficult to collect owing to the cryptic nature of the banteng and the difficulty in locating samples from other sources (e.g. illegally-hunted carcasses). Instead, mtDNA markers have been applied to faecal DNA, and sequences of 1,368bp spanning the cyt-b gene, tRNA and the control region/D-Loop revealed that the population in Tabin, Malua and Maliau contained at least 6 distinct haplotypes (Gardner 2015). This work was expanded and, between the years 2012-2016, a larger number of faecal samples were collected from other forests (Sugut, Sapulut, Segaliud-Lokan, Deramakot, Tangkulap and Paitan, and also Felda Kalabakan oil palm plantation) by DGFC. Combined, the preliminary analysis by Sabah Wildlife Department's Wildlife Health, Forensic and Genetic Laboratory indicates a total of 20 haplotypes (Figure 8); 17 are thought to be of true wild descent, with some unique haplotypes partitioned in the north, east and central regions of Sabah, suggesting geographical barriers may have restricted gene-flow and movement in these areas. Three haplotypes form their own distant cluster and are suspected to be banteng-Bali cattle hybrids that are feral along the boundary of mangrove/Felda Kalabakan oil palm plantation (Figure 9). The Bornean subspecies of banteng is more closely related to the Indian bison/gaur (*B. gaurus*) than it is to the Java (*B. j. javanicus*) or mainland (*B. j. birmanicus*) banteng (Matsubayashi et al. 2014, Gardner 2015). This work is currently in-progress and further effort is being made to substantiate the clustering of haplotypes and to confirm the phylogenetic relationships with other bovid species.

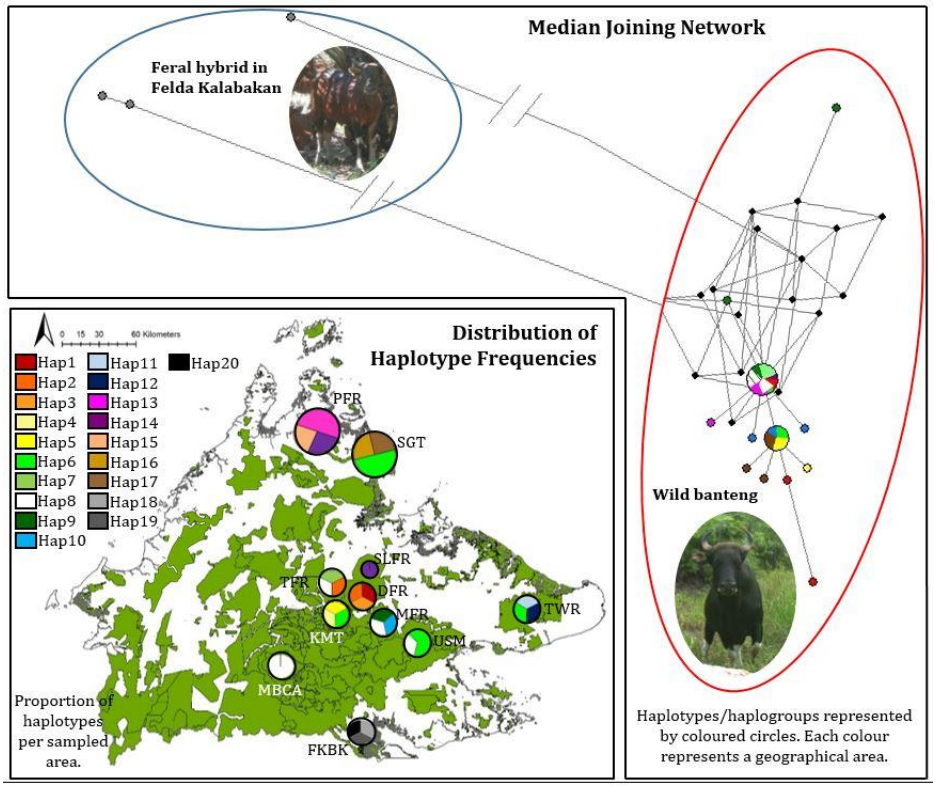

Figure 8. Haplotype network and haplotype frequencies according to the location of their origin, created by Nur Alwanie Binti Maruji and Milena Salgado Lynn.

Figure 9. Suspected hybrid banteng-Bali cattle occupying the fringes of Ladang Felda Kalabakan Oil Palm Plantation. ©Hong Ye Lim

1.5. Current distribution and population trends

Bantengs were estimated to number between 300-500 in 1982 (Davies and Payne 1982), but were thought to have declined to <300 individuals by 1997 (Boonratana 1997). Following a state-wide survey between 2011-2016 by DGFC, localized extinctions have occurred in a number of areas where they were once common (i.e. Lower Kinabatangan, Sukau, Bonggaya, and the Dent Peninsular), owing to land conversion to oil palm plantations (P. Gardner pers. obs.). The present-day population size is estimated at 326 individuals (Table 2), but a number of locations were not surveyed; bantengs may still persist in those locations, therefore their population sizes remain unknown.

Table 2: Known locations of bantengs throughout Sabah and the estimated present-day population sizes. *Confirmed by other sources in previous years, namely researchers, government departments and expeditions, and population sizes unknown.

Location	Confirmed	Minimum number alive
Tabin Wildlife Reserve	Yes	52
Dent peninsular (Lahad Datu)	No	0
Malua Forest Reserve	Yes	36
Danum Valley Conservation Area	Yes	*
Maliau Basin Conservation Area Buffer Zones I & II	Yes	40
Sipitang Forest Reserve	Yes	33
Sapulut Forest Reserve	Yes	16
Kuamut Forest Reserve	Yes	30
Deramakot Forest Reserve	Yes	22
Segaliud-Lokan Forest Reserve	Yes	46
Tangkulap Forest Reserve	Yes	17
Kalabakan Forest Reserve	Yes	*
Sungai Pinangah Forest Reserve	Yes	*
Trusan Sugut Forest Reserve	Yes	2
Sugut Forest Reserve & Mamahat Forest Reserve	Yes	15
Paitan Forest Reserve (Pre-2016 & post-2016 Paitan boundary)	Yes	18
State land southeast of Paitan FR (previously classified as Paitan FR prior to 2016).	Yes	unknown
Ulu-Tungud Forest Reserve (also known as Tunkut FR)	No	0
Silabukan Forest Reserve	No	0
Kulamba Wildlife Reserve	Yes	*
Ulu Segama Forest Reserve	Yes	*

Kabili Sepilok FR	No	0
Sukau and Kinabatangan Wildlife Sanctuary	No	0
Upper reaches of Kinabatangan river	No	unknown
Lower reaches of River Segama and River Kinabatangan	No	0
Ulu Kalumpang Forest Reserve	Yes	*
Malubuk FR	No	unknown
Tawau Hills Park	No	unknown
Kinabalu Park	No	0
Upper reaches of River Padas	Yes	Same region as Sipitang population.
Tanjung Linsang proposed reserve	No	unknown
TOTAL		326

In comparison to prior surveys of bantengs by Davies and Payne (1982) and Boonratana (1997), the distribution of bantengs has retracted and they now largely exist in protected forest reserves, commercial forests, wildlife reserves, and a small area of unprotected land (including natural forest, native rights areas and scrubland adjacent to natural forests). Refer to Figure 10 for the distribution of bantengs from 1978 to 2016. No evidence of (wild, non-hybridized) bantengs was found in oil palm plantations or nipah palm forest. Bantengs did occur in transition zones where the vegetation structure changed from mangrove and freshwater swamp to lowland dipterocarp forest (i.e. east Tabin). Using a mark-resight model with capture histories of identified (recognized using natural marks) and unidentified individuals, density was estimated at 4.39 (CI = 4.39-4.39) individuals per km^2 for Malua Forest Reserve, and between 0.2-0.6 (CI = 0.07-0.56) individuals per km^2 for Tabin Wildlife Reserve (Gardner et al. n.d.).

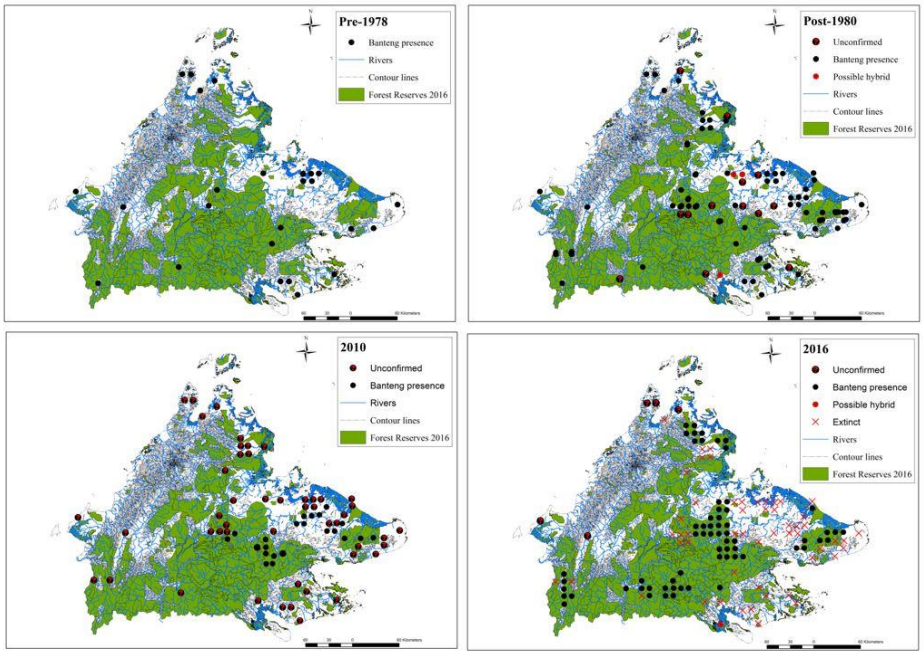

Figure 10. The distribution of bantengs across the state of Sabah from 1978 to 1982 (top, left to right), re-projected from Davies and Payne (1982), in 2010 using data from Boonratana (1997) and Hedges (n.d.), and in 2016 using data collected during the Yayasan Sime Darby state-wide survey of banteng conducted by DGFC. Created by P. Gardner in ArcGIS version 10.1 by ESRI using spatial data from the SFD and Natural Earth.

Using camera trap data, Lim et al. (in press) modelled the distribution of bantengs across the state to estimate suitable and unsuitable habitat for the banteng (Figure 11), and potential ecological linkages for restoration to reconnect core suitable habitat (Figure 12).

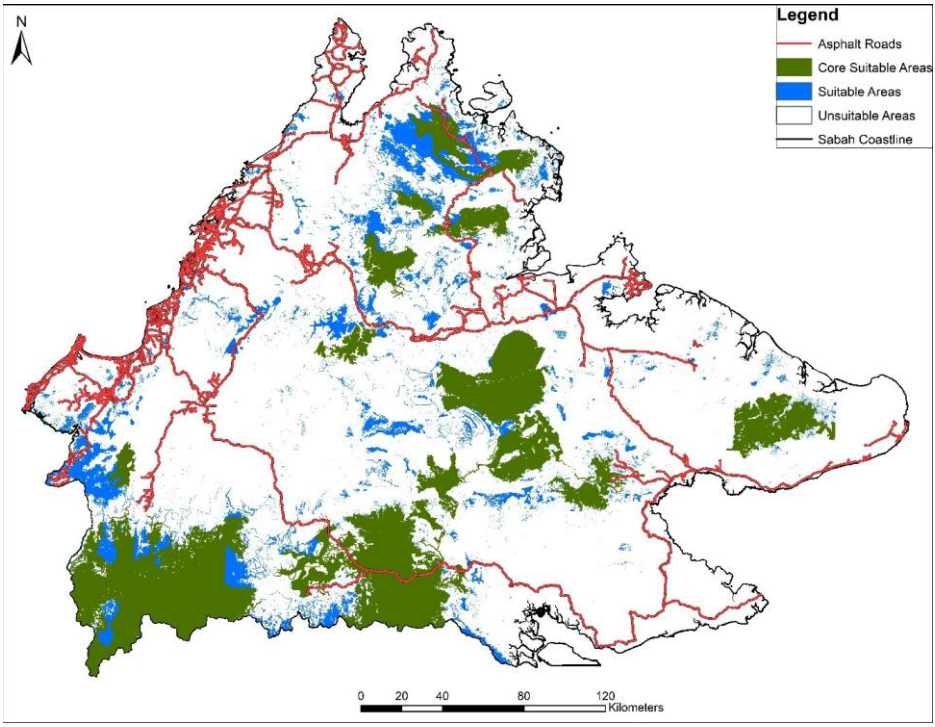

Figure 11: Suitable banteng habitat estimated using species distribution modelling (in MaxEnt) of camera trap data obtained between 2011-2016 (Lim et al. in press).

A total of 11,328 km^2 core suitable habitat was identified from a total area of 72,025 km^2, and over half (55%) of this comprised Production Forest Reserves or commercial forest (Lim et al. in press). Soil association, distance to intact and logged forests, distance to asphalt and gravel roads, and distance to oil palm plantations were the most influential spatial predictors of banteng distribution, and the probability of banteng occurrence declined as the distance to oil palm plantations increased (Lim et al. in press).

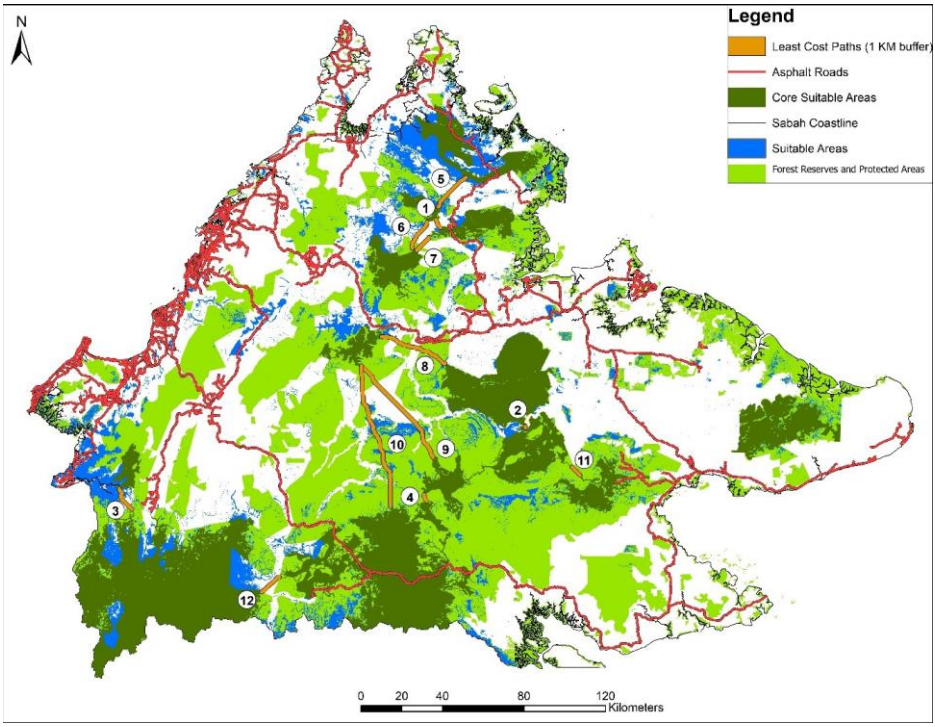

Figure 12: Estimation of ecological linkages across Sabah, with the locations of 12 least-cost pathways connecting core suitable banteng habitat (Lim et al. in press).

Key banteng populations can be broadly classified into four distinct subpopulations, representing the north, east, central and west of Sabah (Figure 13). The central subpopulation occupies the largest forest patch in Sabah which consists of different forest management units (Lim et al. in press).

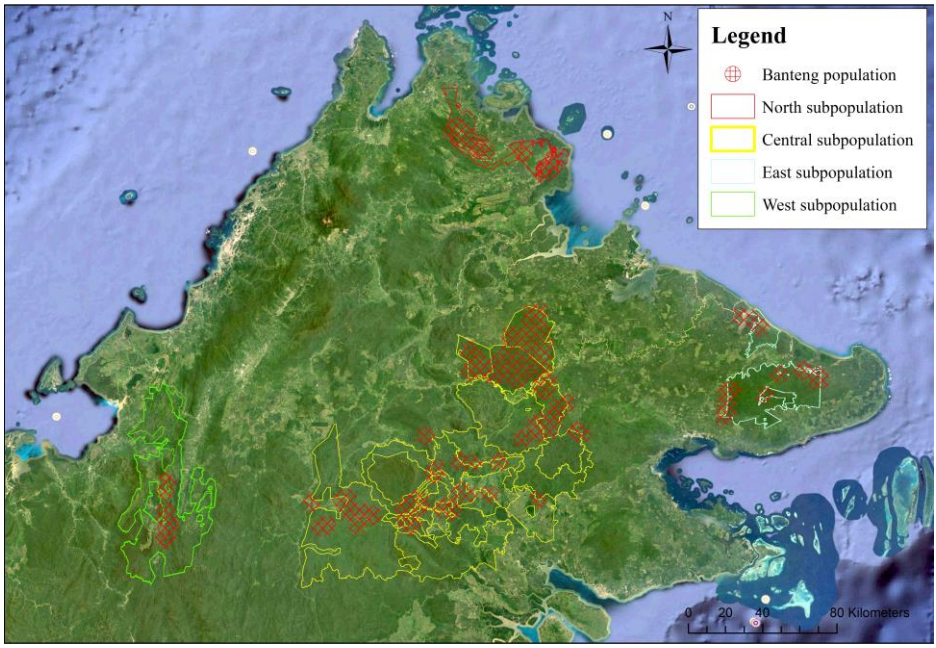

Figure 13. Map of the four banteng subpopulations with the location of the banteng populations (including a 5km buffer) recorded between 2011-2016 by DGFC, created by P. Gardner using ArcGIS version 10.1 by ESRI with spatial data from SFD and Google Earth.

1.6. Major threats

1.6.1. Poaching/hunting and illegal killing

Hunting using firearms is a major threat to bantengs across the state of Sabah, having been repeatedly stated since 1982 (see Davies and Payne 1982, Boonratana 1997). They are viewed, by some, as a desirable target and trophy for sport hunting, and are a valuable bushmeat commodity for personal consumption and for celebrations (e.g. weddings). There is evidence that Bornean banteng meat is also sold by Sabah hunters to customers in Peninsular Malaysia (SFD, pers. comm.). Although unsubstantiated, their horns are thought to contain healing properties. Over recent years, photographs of hunters with banteng carcasses have emerged from near Imbak Canyon, Sipitang, Tabin, Maliau Basin Conservation Area and Ulu-Segama (Figure 14) but there is scarcely any reprisal. The actual number of bantengs killed through hunting is thought to be high, and without accurate data it is difficult to document their declining trend.

Snares are also of concern, as bantengs are caught as bycatch and suffer horrific wounds and potentially fatal wounds as a consequence and, unlike other mammals, it is near impossible to catch individuals to untangle snares caught around their legs. Snare wounds have been identified in commercial forest reserves in the north (Sugut Forest Reserve) and central (Segaliud-Lokan Forest Reserve) regions of Sabah using camera traps (Figure 14).

Figure 14. (top) Newspaper article in 2015 documenting photographs of hunters with banteng carcasses from Ulu-Segama. (bottom) Snare wounds on banteng caught on camera trap: (left) a snare still secured around the hoof of a cow in Sugut Forest Reserve in 2016, and (right) a bull with a missing hoof almost certainly due to a snare in Segaliud-Lokan Forest Reserve in 2015. ©DGFC/SWD

1.6.2. Habitat loss and related fragmentation and degradation

Clear-felling and loss of habitat to permanent agriculture is a serious and ongoing threat (Gardner et al. 2016). Many forests in Sabah were upgraded to Class I Protection Forest in 2016, however they were already highly degraded by extensive removal of timber, compaction of soil leading to erosion and sedimentation of rivers, and loss of canopy cover along newly opened logging roads and stumping grounds. For forests that are Class II Commercial Forest, repeated interval logging causes disturbance, displacement and stress, potentially influencing breeding of bantengs (Gardner et al. 2016). Due to forest clearance to oil palm and other human land uses, much of the lowland dipterocarp forests in Sabah have been lost, clearing what was once likely to be banteng habitat (Lim et al. in press). The present-day distribution of oil palm plantations is a barrier to dispersal (Lim et al. in press); as bantengs do not enter this land-use type, they are confined to forest fragments where they are isolated. In order to prevent isolation of populations, three potential ecological linkages were identified to reconnect banteng habitat: 1) the southern tip of Trus Madi, Sungai Pinangah, and Gunung Rara Forest Reserves, and Maliau Basin Conservation Area, 2) the eastern part of Trus Madi, Tawai, Sungai Talibu, and Tangkulap Forest Reserves, and 3) Deramakot and Kuamut Forest Reserves, crossing Kinabatangan River (Lim et al. in press). In addition, banteng herds in Kulamba and Tabin are closest to each other and a corridor between them is necessary (Lim et al. in press).

1.6.3. Other emerging threats

1.6.3.1. Hybridization with and disease transmission from domestic cattle

Hybridization with domestic cattle (*Bos indicus*) has possibly occurred in the past following the introduction of cows at logging camps. Whilst no obvious hybrids have been detected within forest reserves during a state-wide survey of banteng, without insight at the molecular level it is difficult to detect if hybrids persist in the wild. One confirmed feral hybrid banteng-Bali cattle population persists in the southeast of Sabah, within Felda Kalabakan oil palm plantation in that borders mangrove forest. Preliminary analysis on their molecular structure by Sabah Wildlife Department's Wildlife Health, Forensic and Genetic Laboratory has revealed three haplotypes which are distinct from wild banteng and share commonalities with domestic cattle. We also have

to consider the possibility of disease transmission from livestock to wild banteng.

1.6.3.2. Road development

Sealed asphalt highways that intersect forest (e.g. Maliau/Sapulut and Paitan/Sugut) and unsealed gravel roads that traverse forest (e.g. Sapulut) fragment banteng habitat and reduce the probability of banteng occurrence (Lim et al. in press). Bantengs do forage along abandoned logging roads and in internal openings created by logging (Prosser et al. 2016, Journeaux et al. 2018, Gardner et al. 2018) but the presence of this infrastructure allows poachers to access remote parts of forests by foot, motorcycle, and 4-wheel drive unnoticed (Lim et al. in press).

1.6.3.3. Lack of knowledge and awareness

Bantengs are one of the lesser-known endemic species of Borneo. Locally, they are more widely recognized as a source of bushmeat than for their intrinsic biological value. There is a general preconception that the population size is still large and therefore are not thought of as an endangered species which is in need of conservation. Their inclusion in educational programs is, at present, limited.

1.6.3.4. Reduction of gene flow

The barriers created by monoculture plantations: oil palm (*Elaeis guineensis*), rubber (*Ficus elastica*) and commercial timber across the Sabah landscape, particularly in lowland areas, almost certainly inhibit gene flow between isolated banteng populations. The removal or loss of individuals within a declining and isolated population will also compromise their ability to meet and breed. Together, these factors will increase the probability of an inbreeding depression and accelerate the loss of genetic diversity, therefore increasing the risk of extinction (Lim et al. in press).

1.6.3.5. Geothermal project, gold mining, hydroelectric dam

An EIA submitted in 2010 by Sabah Electricity Sdn Bhd detailed the proposed flooding of primary forest along Sungai Padas, within Sipitang forest (P14, P7, P8, P20, P21) and the construction of a hydroelectric dam to power nearby communities. There was limited acknowledgement of the impact upon banteng within this area. The following text is taken from the EIA for “The proposed Upper Padas Hydroelectric project, Sabah: *“Earlier reports from particularly the*

WWF that there should be some Tembadaus (Banteng, Bos javanicus) in the Ketanun area cannot be confirmed from field observations. Workers and villagers in the area do, however, report that Tembadau occasionally is seen. The Wildlife Department has confirmed this but is of the opinion that it may be a few roaming individuals rather than an actual population". The location of this dam will, in effect, fragment banteng habitat, creating an obstacle for banteng in Sipitang Forest Reserve, which will prevent them from moving across the landscape between primary forest in P8 and P21 to secondary forest in P7, P14, P19 and P20.

2) REGIONAL MANAGEMENT UNITS

2.1. Sipitang

Sipitang Forest Reserve, including Ulu Sungai Padas Forest Reserve, is situated on the west coast of Sabah and is managed primarily as an industrial tree plantation (*Eucalyptus grandis* and *Acacia sps*) but also contain areas managed as natural forest. The industrial and natural managed forest areas span 2,881.38 km^2 and the licenses are held by Sabah Forest Industries (SFI) Sdn Bhd (Avantha Group) until 2095 (Sabah Forest Industries 2011).

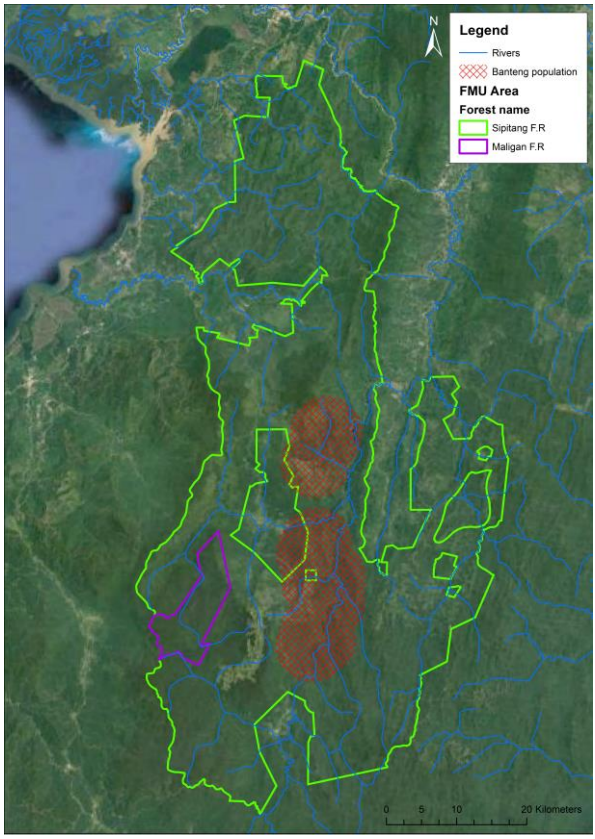

Figure 15. Location of the banteng population (including a 5-km buffer) within Sipitang Forest Reserve, recorded in 2013-2014 by DGFC, created by P. Gardner using ArcGIS version 10.1 by ESRI with spatial data from SFD and Google Earth.

Bantengs in Sipitang Forest Reserve are thought to number approximately 42 individuals: 12 bulls, 15 cows, six calves and a further nine unknown individuals (Gardner and Goossens unpublished). They were found occupying forest at 11598 m a.s.l, which is the highest known elevation for bantengs in Sabah. In light of this and due to the sheer size of this forest, there remains considerable potential for further banteng surveys to explore the presence of populations in other areas of Sipitang. The banteng population was confirmed in the central region of Sipitang within scrubland, natural forest and in mature ITP close to natural forest (Figure 15). On the rare occasion, their signs (dung) were seen by SFI contractors across the main unsealed road that divides the reserve. The bantengs here have access and probably utilize primary forest and are probably one of the last populations that are able to do so. Bantengs were previously recorded close to the Sarawak border (Davies and Payne 1982) however no sightings or signs were detected on this survey. Bantengs may still persist in Ulu Sungai Padas Forest Reserve, which is located in the south-western tip of Sabah, south of Sipitang, Maligan and Gunung Lumaku, and is still an area of high biodiversity.

2.2. Paitan and Sugut

Known bantengs in the north of Sabah are divided into two distinct areas, Sugut (Trusan Sugut Forest Reserve, Sugut Forest Reserve and Mamahat Forest Reserve) and Paitan Forest Reserves (Figure 16). Both areas are predominantly commercial forests, managed by Asian Forestry Company/Forest Solutions Malaysia Sdn Bhd and Eco-Plantations Sdn Bhd, and contain ITP (rubber plantation in Paitan), oil palm in Sugut, and natural forest that is logged over. The forest degradation in Sugut and Mamahat is particularly severe and would benefit greatly from restoration and replanting.

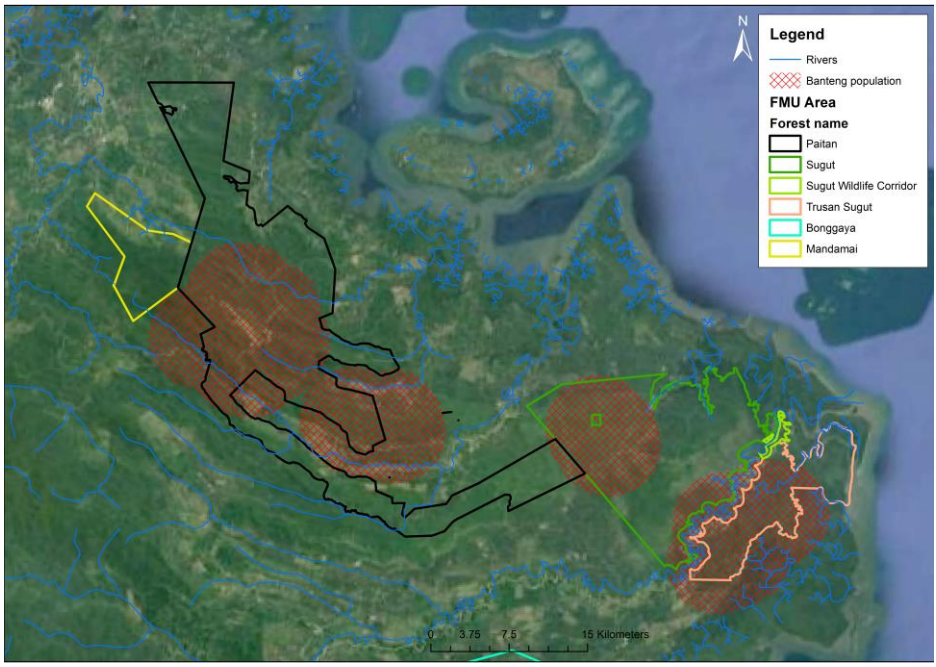

Figure 16. Location of the banteng population (including a 5-km buffer) in the north of Sabah within Sugut and Paitan, recorded by DGFC in 2016, created by P. Gardner using ArcGIS version 10.1 by ESRI with spatial data from SFD and Google Earth.

Bantengs in this area were surveyed using camera traps in 2016 by DGFC and are thought to number approximately 51 individuals, comprising 17 bulls, 14 cows, six calves and 14 unknown individuals (Gardner and Goossens unpublished). One cow was badly injured by a snare, which was entangled around her swollen hoof (refer back to Figure 14). The banteng population was found inhabiting ITP (rubber plantation) that had been left unmanaged due to the low price of rubber which had made harvesting uneconomical. They were also present within swamp and dry lowland forest including the highly degraded areas within Sugut and Mamahat, and in the degraded natural forest outside of the Paitan Forest Reserve boundary, which was previously included in the reserve prior to 2016.

2.3. Central Forest

The Central Forest comprises a large number of Class I and Class II FMUs managed as ITP, sustainable forest management for timber production, biodiversity conservation, and educational purposes/scientific research by different concession-holders. Forest reserves include Deramakot and Tangkulap managed by the Sabah Forestry Department, Segaliud-Lokan managed by KTS Plantation Sdn Bhd, Malua, Ulu Segama, Kuamut, Gunung Rara Forest Reserves, Maliau Basin and Danum Valley Conservation Areas managed by Yayasan Sabah, and Sapulut managed by Sapulut Forest Development Sdn Bhd, to name a few.

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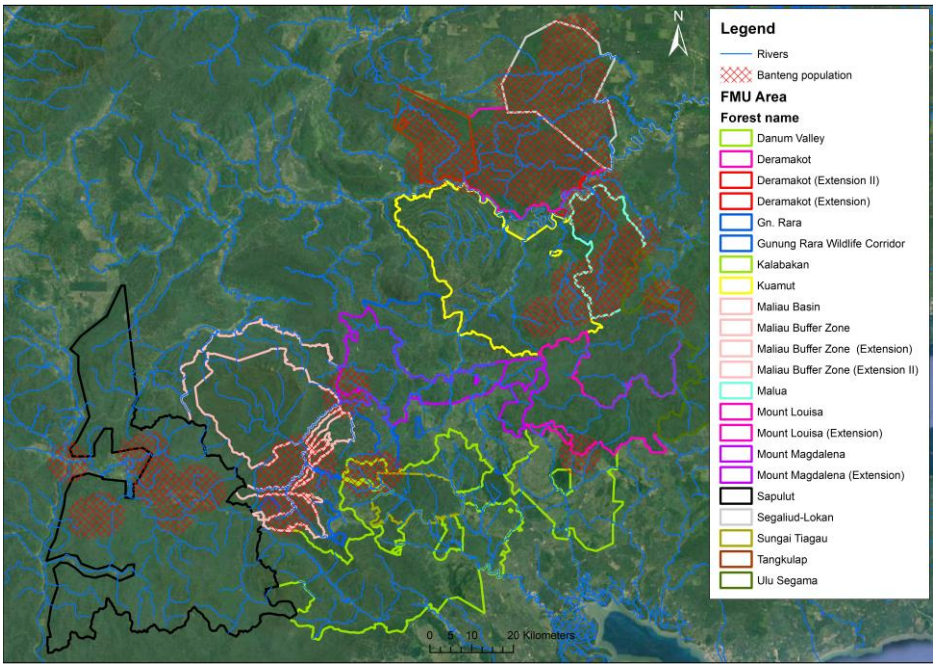

Figure 17. Location of the banteng population (including a 5-km buffer) in the central forest reserves of Sabah, recorded by DGFC between years 2011-2015, created by P. Gardner using ArcGIS version 10.1 by ESRI with spatial data from SFD and Google Earth.

Bantengs have been caught on camera trap within Tangkulap, Deramakot, Segaliud-Lokan and Maliau by a number of researchers,

expeditions and SFD staff over the past few years. Between 2011-2015 bantengs were located in the following areas by DGFC: Malua, Kuamut, Maliau, Sapulut, Tangkulap, Deramakot, and Segaliud-Lokan (Figure 17). Bantengs are also known to occur in Danum, Ulu Segama, Kalabakan, and possibly Sungai Pinangah but these locations were not surveyed, thus are not included in the population size estimate. Bantengs were also confirmed south of the Central Forest, in Ulu Kalumpang Forest Reserve, by SFD in 2014. Banteng in this area are thought to number approximately 197 individuals (at least 10 individuals roam between both Malua and Kuamut), comprising 99 bulls, 77 cows and 31 calves (Gardner and Goossens, unpublished). They were located within natural secondary forest, scrubland and riparian areas, along abandoned logging roads, and in highly degraded open areas (old stumping grounds). No cameras were established within primary forest. Within Malua, the density of bantengs was estimated at 4.39 (CI= 4.39-4.39) individuals per 100km (Gardner et al. n.d.).

2.4. Tabin and Kulamba

Tabin and Kulamba Wildlife Reserves are the only two known locations in the east of Sabah that still contain bantengs. They are Class VII reserves and thus totally protected against logging, however they were logged (but very small parts of Kulamba) previously and are in fact secondary forest. Both forests contain a variety of unique vegetation including, for Kulamba: beach forest, peat swamp, mixed lowland dipterocarp forest, freshwater swamp and mangrove, and for Tabin: nipah palm, mangrove, freshwater swamp, lowland and upland mixed dipterocarp. Both reserves are managed jointly by SWD and SFD.

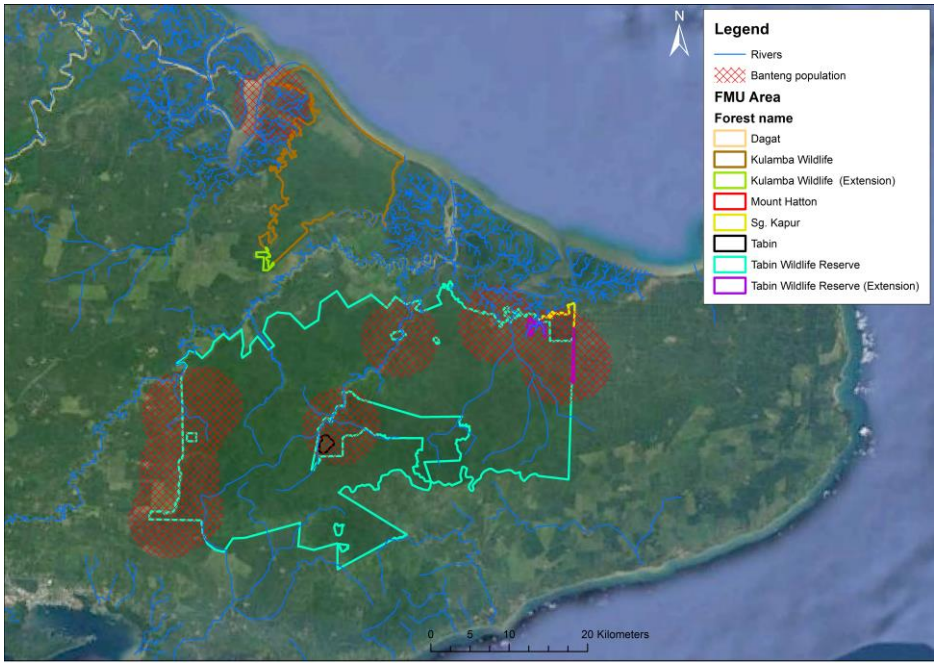

Figure 18. Location of the banteng population (including a 5-km buffer) in the east of Sabah, within Kulamba Wildlife Reserve, and also within Tabin Wildlife Reserve between years 2011-2015 by DGFC, created by P. Gardner using ArcGIS version 10.1 by ESRI with spatial data from SFD and Google Earth.

Bantengs are a well-known occupant of these reserves and have been observed in Kulamba during heli-surveys and by the police, and in Tabin on camera traps by a number of researchers over the past few years. DGFC surveyed bantengs in Tabin between the years 2011-2012, and conducted a short recce in Kulamba in 2016, but due to time limitations a full survey was not conducted. Bantengs were located within the north, east, central and west of Tabin, and in the north of Kulamba (Figure 18). No estimates are available for Kulamba from this study, but they are thought to number around 100 individuals (A. Hamid pers. comm. in Timmins et al. 2008). In Tabin, they are estimated at approximately 52 individuals. More are known to persist in swamp in the north but this area was not surveyed using camera traps. The density of bantengs in Tabin has been estimated at 0.2 (CI= 0.07-0.6) to 0.6 (CI=0.3-1.1) individuals per 100 km^2 (Gardner et al. n.d.).

3) NON SITE-SPECIFIC PRIORITY ACTIONS

OBJECTIVE 1. LAW ENFORCEMENT AND PATROLLING
Action 1.1: Combat banteng poaching
Rationale: There is a need to increase the capacity and effectiveness of the State's agencies in combatting banteng poaching.
Resources available: 1. Existing PROTECT team at SFD. 2. Network of Honorary Wildlife Wardens (under SWD). 3. Enforcement unit at Sabah Foundation focusing on DaMaI Rainforest Complex. 4. SWD wildlife and enforcement officers. 5. Conservation units by concession holders upholding existing protocols on forest management. 6. Network of researchers collecting data in the field. **Resources not available:** 1. Increase the capacity of PROTECT team with additional rangers and one crime analyst (intelligence unit using the SMART intelligence platform). 2. Increase the capacity of DaMaI enforcement unit. 3. Improve efficiency of HWW network (systematic HWW training could be given to security personnel of private sector companies whose properties are within banteng ranges). **Measures to be taken:** 1. Establish SMART patrols across all banteng ranges and standardise the reporting system and the data base (real time monitoring). There should be a centralised person that collects and analyses all the data (based at SWD or SFD headquarters). Ensure proper training in SMART data entry is given to at least one enforcement officer per site. 2. Hire and train crime analysts, investigators and intelligence gatherers to use the SMART intelligence platform and train a certified forensic technician at the Sabah Wildlife Health, Genetic and Forensic Laboratory. 3. Enforcement of gate use and increase of security at access points by setting up camera traps and increasing the presence of armed guards. Keys for gates which border forest reserves (i.e. Tabin) should not be provided to oil palm estates. 4. Assess the level of hunting in Sabah by gathering all poaching information. For example share data on poaching collected during camera-trapping surveys. The centralised information should be

provided to the enforcement authorities to target anti-poaching activities.
5. Carry out undercover operations in bushmeat markets.
6. Enforce a zero snaring policy in Sabah's protected areas, forest reserves, forest plantations and oil palm plantations.
7. MoU between oil palm plantations adjacent to protected areas and enforcement agencies (SFD, SWD) stipulating 'no hunting' must be signed and enforced.
8. Pay reward to valid informants leading to prosecution of poachers.
9. Active training programme on self-defence and firearms training to empower officers and checkpoint personnel or reinstall confidence.
10. Ensure that at least one officer at each site is equipped with a firearm and the firearm license is continuously updated and kept valid.
11. Ensure that a specific enforcement plan is included in all SFMLAs to make sure that patrolling is carried out regularly and there is an annual work plan and a budget to implement the activities.
12. Increase joint patrolling by District-level anti-poaching task force and constantly update on poachers' activities via Whatsapp group.
13. Identify trade routes and modus operandi of poachers/traders and establish strong collaboration between State Level Wildlife Trade Task Force and Transboundary Enforcement Network (HoB).

Priority:
1. One person at SFD or SWD headquarters to compile all SMART data.
2. Two years for PROTECT and DaMaI enforcement units to be operational and confident in the use of SMART to document all patrols.
3. Two years to train a crime analyst and an intelligence gathering team in the use of SMART for queries and the SMART intelligence platform.
4. Two years for at least one officer at each site to be familiar and confident in the use of SMART for data entry.
5. Three years to train a forensic technician at SWHGFL.

Lead agencies: SFD (PROTECT), SWD (Enforcement team), SF (DaMaI)

Partners: WWF-Malaysia (Enforcement team), NGOs (HWW), OPP, SWHGFL, DGFC

Success measure/indicator:
1. Decrease of poaching and trade in Sabah.

2. Increase of prosecutions of wildlife criminals in Sabah.
3. SMART database established.
4. Data base on enforcement operations established for each department and shared between departments.
5. Appointment and training of forensic technician for laboratory.
6. Biannual training on firearms and defence.

OBJECTIVE 2. CAPTIVE BREEDING AND CRYOPRESERVATION

Action 2.1: Set up a captive breeding program in Sabah

Rationale: The number of wild bantengs is less than 500, making the species the most endangered large mammal in Sabah. A captive breeding program to boost the number of bantengs in Sabah is therefore of great importance.

Priority: 10 years

Lead agencies: SFD, SWD

Partners: BORA, UMS, DGFC, AWCSG, CPSG

Measures to be taken:
1. Establish a small committee of experts (in cattle, pasture, large mammal capture) for putting together a plan and identify the different stakeholders.
2. Identify successful captive breeding programs in Asia and learn from them (training, BGSMP).
3. Identify a suitable location for the establishment of a captive breeding facility.
4. Prepare a budget and secure funding for infrastructure, required personnel (veterinarian, husbandry, administration), etc.
5. Plan and deliver training programmes through knowledge-exchange on techniques covering husbandry, movement, capture, breeding, etc.
6. Identify a suitable population where harvesting of individuals may not be too detrimental or individuals that are currently very vulnerable.
7. Evaluate suitable methods of capture.
8. Implement capture procedures.

Success measure/indicator:
1. A network of international and local specialists and stakeholders is formed.
2. Funding is secured for training, appropriate facilities and location.
3. Staff are trained in captive breeding techniques.
4. Facilities are secured and husbandry protocols are in place prior to stock arrival.

5. Suitable capture methods are agreed and implemented.
6. Individuals are secured from wild population.
7. Molecular description and screening of individuals is conducted to avoid inbreeding and disease.
8. Initiate breeding or IVF program.
9. Healthy offspring are produced.

Action 2.2: Cryopreservation of gametes and cell culture

Rationale: Cryopreservation is a method whereby cells are frozen, maintaining their viability, until they are defrosted months or years later. Cryopreservation provides a source of genetic material that can help sustain genetic diversity long-term and can be used to produce living animals in the future. Semen and embryos produced in vitro can be cryopreserved.

Priority: 10 years

Lead agency: SWD

Partners: UMS, BORA, SaBC

Success measure/indicator: Banteng tissue is cryopreserved.

OBJECTIVE 3. MAINTAIN SUITABLE HABITAT FOR BANTENGS

Action 3.1: Prevent any loss and degradation of suitable habitat (open grassy and sedge areas and forest shade) for bantengs. Any area with presence of bantengs must be managed sustainably by developing and maintaining pastures within and near the home ranges of the existing herds.

Rationale: Improving the habitat for bantengs can drastically improve the future prospect of the species. Maintaining pastures in banteng habitat will provide enough quality food to increase their productivity. Maintaining forest will provide shade and protection.

Priority: 10 years

Lead agencies: SFD, SF, SFI

Success measure/indicator: An increase of pastures in banteng range.

OBJECTIVE 4. ESTABLISH AND MAINTAIN LANDSCAPE CONNECTIVITY THROUGHOUT THE RANGE OF BANTENG

Action 4.1: Identify potential connectivity within and between banteng regional management units and establish connectivity within and between regional management units.

Rationale: Small populations are more likely to go extinct; keeping them connected increases likelihood of persistence, allows for rescue of declining populations through immigration, and promotes long-term genetic viability.
Priority: 10 years **Lead agencies:** SFD, SF, SFI **Recommendation:** Use the information published in Lim et al. in press: Oil palm development threatens the endangered Bornean banteng in Sabah, Malaysia. *Oryx*. **Success measure/indicator:** (East) Tabin Wildlife Reserve and Kulamba Wildlife Reserve are reconnected. (North) Paitan Forest Reserve is reconnected with Sugut. (Central) Connectivity is established within central forest reserves, and efforts are ongoing to reconnect (West) Sipitang to central forest reserves.
OBJECTIVE 5. RESEARCH
Action 5.1: Assess the level of hunting in Sabah by gathering all poaching information and carry out undercover operations in bushmeat markets.
Rationale: We need to get a better understanding of hunting and the threats to banteng by gathering poaching data.
Priority: 2 years **Lead agencies:** SWD, SFD, UMS, DGFC, WWF-Malaysia, SaBC **Success measure/indicator:** Poaching data are collected.
Action 5.2: Carry out a risk assessment of the presence of domestic cattle and potential hybrids within and around protected areas (Kalabakan Forest Reserve, Tabin and Kulamba Wildlife Reserves,…).
Rationale: Interspecific hybridization can result in the disintegration of genetic integrity and the loss of native genetic variation or locally adapted gene complexes (genetic swamping). In addition, the presence of hybrid animals in remaining populations of threatened species may result in legal challenges to their protected status. Consequently, interspecific hybridization has become an increasingly important issue in species management. It is therefore important to carry out an assessment of potential hybridization in the wild banteng

population and correctly identify individuals or populations with hybrid presence.

Priority: 2 years

Lead agencies: UMS, SWD, DVS, UMS, SWHGFL, SaBC

Success measure/indicator: Locate all known/suspected hybrid herds and ensure they are segregated from wild populations by containment/fencing/capture/relocate to secure habitat absent of wild bantengs.

OBJECTIVE 6. EDUCATION AND AWARENESS

Action 6.1: Disseminate awareness materials on banteng to relevant stakeholders in the vicinity of the protected areas (local communities, oil palm workers).

Rationale: The level of awareness about banteng and wildlife conservation within the local communities and oil palm workers in the vicinity of protected areas is very low. It is important to disseminate information about wildlife laws within local communities and oil palm estates.

Priority: 10 years

Lead agencies: SWD, SFD, SF, SEEN, DGFC, BSBCC, HUTAN, PACOS Trust

Success measure/indicator:

1. Community outreach/education programmes contain up-to-date information, images and props on bantengs and their conservation.
2. The number of community outreach programmes in areas containing bantengs are increased.
3. New locations are targeted by the outreach programme (communities, schools, and oil palm company management).

Action 6.2: Use banteng as a conservation icon for protected areas such as Sipitang Forest Reserve, Maliau Basin, Kulamba Wildlife Reserve, Paitan and Sugut Forest Reserves.

Rationale: Protected areas such as Sipitang Forest Reserve, Kulamba Wildlife Reserve, Paitan and Sugut Forest Reserves in which the banteng is the largest mammal present, would benefit from adopting the banteng as a conservation icon.

Priority: 2 years

Actors responsible: SF, SFI, SFD, SWD

Success measure/Indicator: Sipitang Forest Reserve (and SFI), Paitan and Sugut Forest Reserves adopt the banteng as a conservation icon and promote conservation of the species in the reserves.

Action 6.3: Instigate and promote a World Banteng Day.

Rationale: Sabah could instigate a World Banteng Day to recognize the national conservation efforts to protect this charismatic species and its habitat.

Priority: 1 year

Actors responsible: SWD, SFD, SF, AWCSG

Success measure/Indicator: A World Banteng Day is identified and celebrated every year in Sabah. An alternative event could be a one-off 'Year of the Banteng' in 2021 to coincide with the Chinese Year of the Ox. Promotion of the species could be done with real-life decorative models of bantengs for hashtag selfies (photos) and wildlife information leaflets or information board, and these could travel throughout Sabah visiting the airports, towns and cities. Additionally, local competitions could be set up with prizes (potentially advertised through local newspapers and outreach programmes, Kota Kinabalu Museum, visitors through airports etc) which encourage the community and visitors to get involved, such as (e.g.) drawing a picture of a banteng to send it and displayed at a prominent location, writing a story, sending in a photograph of a banteng.

OBJECTIVE 7. MONITORING

Action 7.1: Set up an Endangered Species Conservation Unit (ESCU) that will monitor the implementation of all action/conservation plans on totally protected (Schedule 1) terrestrial species in Sabah: elephant, banteng, proboscis monkey, orangutan, Sunda clouded leopard, Malayan sun bear and Sunda pangolin.

Rationale: Sabah Wildlife Department, the custodian of wildlife in Sabah, need assistance to implement these endangered species action plans. ESCU will provide manpower and expertise to monitor the implementation of the action plans, meet with the different stakeholders and prepare the annual reports and mid-term reviews for each action plan.

Priority: 10 years

Lead agency: SWD

Partners: NGOs, DGFC, UMS

Success measure/indicator: The action plan is implemented. A short review is carried out every year by ESCU. A mid-term review is drafted after 5 years by ESCU.

4) SITE-SPECIFIC PRIORITY ACTIONS

4.1. Sipitang

The Sipitang banteng population is the only population located in the west coast of Sabah, it is a small population (minimum of 42 individuals), completely isolated from the Central Forest population. It is therefore critical to make every effort to boost numbers in Sipitang and to increase enforcement as poaching is one of the main threats to the population. See Figure 19 for a photograph of bantengs in Sipitang.

Action 1. Prevent poaching of banteng by increasing patrolling in the forest reserve and its vicinity, prohibiting hunters to enter the reserve (including in 4x4) and increasing road blocks/checkpoints inside and outside the reserve (many poachers are coming from large cities such as Kota Kinabalu, Keningau, etc).

Action 2. Make every effort to maintain connectivity within Sipitang Forest Reserve and to reestablish connectivity with the Central Forest population.

Action 3. Map the current land use in the reserve in order to provide accurate information on habitat quality and any illegal encroachment and development projects. This work could be initiated by SFI, DGFC and SFD and could begin immediately by using hunting information collected in 2014 by DGFC. Profiles of specific vehicles and hunters within the reserve may be created from camera trap images by DGFC to supply evidence for enforcement and prosecution by SFI and SFD.

Action 4: Establish and monitor (using camera traps) artificial salt licks at critical areas.

Action 5: Establish a population monitoring program to gather information on population size dynamic, breeding evidence, sex-ratio and threats. This constant monitoring could be established by SFD and SFI with assistance from DGFC or UMS.

Action 6: Collect genetic samples from Sipitang Forest Reserve to complete the phylogeographic assessment of the banteng populations

in Sabah. Locations of potential collection sites and collection techniques to be used can be provided by DGFC.

Action 7: Make every effort to boost naturally the population size in the reserve by preventing the loss of the existing banteng population. Install robust and lockable manned and unmanned gates to prevent unwanted vehicle access to compartments occupied by banteng that were identified by DGFC. Knowledge exchange to ensure the most appropriate gates are installed for each situation to prevent wasted resources. If a captive breeding program is established, consider Sipitang population as a sink population.

Action 8: Establish transboundary collaboration with Sarawak and potentially Kalimantan to carry out joint monitoring, sharing information and enhance protection of wildlife.

Action 9: Conduct a wildlife expedition to South Sipitang along the Indonesia/Malaysia border to investigate the possibility of a banteng refuge in this secluded region, and to identify if there is transboundary movement of bantengs.

Action 10: Explore the potential for a grassroots ecotourism initiative on bantengs within Sipitang between SFI and Long Mio and Long Pasia, using existing tourism programme and tourists channelled from Kota Kinabalu.

Action 11: Empowerment of multiple SFI staff by undergoing firearms training for enforcement purposes to reinforce Action 1.

Figure 19. A herd of bantengs in Sipitang Forest Reserve. ©DGFC/SWD

4.2. Paitan and Sugut

The Paitan-Sugut banteng population is totally isolated from Sabah's other banteng populations and it is unlikely that connectivity can be re-established. See Figure 20 for a photograph of bantengs in Paitan. It is therefore critical to make every effort to boost numbers in Paitan-Sugut population by:

Action 1. Prevent poaching of bantengs by increasing patrolling in the two forest reserves and especially within Paitan (Ecoplantation concession), Sugut (Ecoplantation concession) and in and around Mamahat Forest Reserve. Increase road blocks on Jalan Tikus and logging roads.

Action 2. Map out all oil palm plantation roads and old logging roads in the area for a better monitoring of poaching activities by the stakeholders (SFD, Forest Solutions Malaysia). Alternate or complimentary option could include remote mapping of roads using drones and/or satellite imagery.

Action 3. Establish a network of monitoring cameras (potentially MMS cameras in areas with network signal) for stakeholders to collect information on encroachment and hunting activities, and consequently to make informed decisions on enforcement.

Action 4. Promote and increase consultations with villagers through regular meetings with community committees to promote protection of the reserves. Increase patrols by stakeholders in the two protected areas.

Action 5. It is currently unknown whether animals move between Paitan and Sugut Forest Reserves. It is therefore critical to promote connectivity between Paitan and Sugut Forest Reserves, which is currently broken by Kanibongan-Sapi Nangoh Road and an unsealed road maintained for palm oil companies and villagers. Initiate talks between stakeholders (SFD, concession holders, SWD and other stakeholders) to discuss potential options (e.g. culvert, roadside replanting for additional cover, small bridges, and rope bridges as viable option for arboreal wildlife).

Action 6. Use and develop abandoned logging roads as managed pastures. Plant species that colonise pasture grass should be identified. Artificial salt licks should be established and monitored at critical areas.

Action 7. Establish a population monitoring program to gather information on population size dynamic, breeding evidence, sex-ratio, threats. This constant monitoring could be established by SFD with assistance from DGFC or UMS.

Action 8. Develop activities/incentives for local communities in order to decrease poaching and reducing the need to hunt for food (tuhau plantation, swiftlet farming, stingless bees project, etc).

Action 9: Regular patrolling, ambushing and road blocks along Nangoh Paitan Kanibongan Road (between Kampung Paitan and simpan Jalan Kaniongan): hunters often park their cars overnight along the roadside whist they hunt inside Paitan Forest Reserve, and also occasionally excavate access for vehicles into the reserve from this road.

Action 10: Regular undercover monitoring of Kanibongan weekly market for banteng meat but also for other wildlife products.

Action 11: Initiate an ecotourism initiative for Paitan-Sugut that encourages footfall of tourists to this area interested in nature, with the banteng as a key attraction. Other potential attractions are bird spotting, jungle walks, sleeping under the stars in Trusan Sugut observation tower, river cruises, prawn fishing along the rivers, a homestay programme, visits to the local schools. Handicrafts, food-tasting and local cooking classes could be alternate ecotourism avenues to increase income in this particularly poor area of Sabah.

Figure 20. Bantengs in Paitan Forest Reserve. ©DGFC/SWD

4.3. Central Forest

The Central Forest population is the largest in Sabah with a minimum of 197 individuals. See Figure 21 for a photo of bantengs in Segaliud-Lokan Forest Reserve. The major threats are poaching and habitat disturbance and fragmentation.

Action 1. Prevent poaching of bantengs by increasing patrolling in hotspot areas such as the buffer zone of Maliau Basin Conservation Area, Kalabakan, Ulu Segama, Kuamut and Pinangah Forest Reserves. Prevent poaching access to the Maliau Basin Conservation Area Buffer Zones by installing barriers to limit parking opportunities along the highway, especially in and around entry points to Sungai Kuamut near the Maliau Basin Security Gate. Regular documentation of car models/makes/plate numbers parked overnight in these areas with this information used for investigations and crime analysis.

Action 2. Prevent any process that would further fragment the habitat of the banteng populations between Sapulut Forest Reserve and Maliau Basin Conservation Area. Make every effort to minimize the impact of the Pan Borneo Highway on the banteng population in Sapulut Forest Reserve by designing and establishing animal crossings such as culverts, tunnels or bridges. Engage with JKR engineers during the design and alignment of the Pan Borneo Highway in sensitive banteng areas. Prevent important roadside banteng grazing areas to be used during the road construction process.

Action 3. Make every effort to maintain connectivity within Central Forest.

Action 4. Investigate the movement of bantengs within forests containing a mosaic of mature natural forests and ITPs, particularly rubber, acacia and eucalyptus plantations where bantengs are known to occur.

Action 5. Cease camping of contractors (logging and road excavators, etc) within the forest and along forest roads, and relocate to designated houses to prevent hunting.

Action 6. Identify critical open areas (grassland) for bantengs and establish a zoning for grassland in protected areas.

Action 7. Establish a state-wide camera trapping survey for banteng at salt licks and compare visitation rates between artificial and natural salt licks. Investigate the possibility to increase the number of artificial salt licks in critical areas for banteng.

Action 8. Design proper and feasible methods for banteng population monitoring.

Action 9. Establish transboundary collaboration with East Kalimantan to assess whether banteng cross between Sabah and Kalimantan, and whether there is any intrusion of foreign poachers within Sabah.

Action 10. Share the action plan with all SFMLA, local communities and estate holders in the vicinity of Central Forest area.

Action 11. Collect evidence of hybridization between domestic cattle and banteng and ban presence of domestic cattle nearby banteng populations. If necessary, cull any hybrid/feral cattle that can be in contact with the wild population of banteng or isolate them from the wild population.

Action 12: Design a series of guidelines/protocols within the sustainable logging remit that take further steps to reduce the impact upon banteng and other mammals within commercial forests. Evaluate these methods by trials in a small number of reserves.

Action 13: Increase the information on bantengs available for tourists and visitors within information buildings, nature lodges and study centres within the central reserve by knowledge-sharing with stakeholders. Instigate discussions with same stakeholders on ways to increase banteng nature-tourism and awareness.

Figure 21. Bantengs in Segaliud-Lokan Forest Reserve. ©DGFC/SWD

4.4 Tabin and Kulamba Wildlife Reserves

Tabin and Kulamba Wildlife Reserves are the only locations in the south-east of Sabah that harbour banteng. Both reserves are currently connected but only by a thin tree line along a riparian corridor, which is unable to provide sufficient cover for bantengs. Both reserves are disconnected from the other populations in Sabah. See Figure 22 for a photo of a banteng bull in Tabin. Tabin harbours a minimum of 52 individuals (although the whole reserve has not been surveyed) and Kulamba harbours a minimum of 100 individuals.

Action 1: Develop and maintain pastures within and near the home ranges of the existing banteng herds, so they have enough quality food to increase their productivity and range.

Action 2. Prevent any process that would further fragment the habitat of the banteng populations within and between Tabin and Kulamba Wildlife Reserves such as roads and new oil palm plantations. A strict ban on any road development must be instigated by the government.

Action 3: Re-establish connectivity between Tabin and Kulamba Wildlife Reserves by acquiring, protecting and restoring (with pastures) approximately 1,000 ha of blocking oil palm estates.

Action 4. Prevent any poaching of banteng in the two reserves by: 1. Increase the number of SMART patrolling and trained/armed rangers in the two reserves; 2. Prevent issuing licenses for hunting around the two reserves; 3. Increase road blocks. 4. Install a check point and small house by main west gate, and man this check point and lock the gate at night. 5. Repair SWD house/station in Kg. Dagat and increase officer presence and patrolling activity in this area. 6. Increase patrolling activity and presence in east Tabin, with checks on markets within Felda Sahabat Plantation for banteng bushmeat.

Action 5. Hybridization and transfer of disease from domestic cattle. Survey, monitor and identify domestic cattle and hybrids in the wild using drone and camera trapping. Removal of these animals by Sabah Wildlife Department. Raise awareness among cattle holders. Erect well-planned barriers to separate domestic cattle and wild banteng.

Action 6: Identify and provide livelihood programs for the local communities surrounding the two reserves. Integrate the local communities into the security concept by training and entrusting Honorary Wildlife Wardens.

Action 7. Increase awareness of the species by: 1. Distribute current outreach community outreach/education programmes with information and resources on banteng conservation. 2. Delivery this programme to areas including Kg. Dagat, Felda Sahabat Plantation (workers, management and security staff), local rural schools and other communities including newly established plantations in north Tabin. 3. Engage with local nature lodges to provide information and resources on bantengs to educate tourists on their presence and critical status. 4. Evaluate the potential for SWD to deliver small but frequent banteng walk/night spotting/talk within Tabin to tourists to increase awareness, increase footfall to Tabin, and to attempt securing ongoing funds for banteng conservation.

Figure 22. A banteng bull in Tabin. ©DGFC/SWD

5) IMPLEMENTATION, MONITORING, EVALUATION AND BUDGET

5.1. BBAP implementation

This is a 10-year action plan (2019-2028). In order for this plan to achieve its ultimate objective of securing the future of the Bornean banteng in Sabah, all recommendations should be evaluated by SWD and endorsed by the Sabah State Cabinet.

The implementation of the BBAP remains the responsibility of SWD. However, assistance from other relevant government departments such as SFD, SF and SP will be provided.

It is proposed that a SPECIES ACTION PLAN COMMITTEE led by Ministry of Tourism, Culture and Environment is created, consisting of members from relevant NGOs, research institutions and government departments that will assess the implementation for each species action plan (elephant, orangutan, proboscis monkey, Sunda clouded leopard, Bornean banteng and any future action plans (sun bear, pangolin,…)). The relevant NGOs in Sabah are namely: HUTAN, LEAP, WWF-Malaysia, SET, PACOS,…. The relevant research institutions in Sabah are namely: UMS, SEAARP and DGFC. The relevant government departments in Sabah are namely: SFD, SF, SP, SLSD, DID, MAFI.

5.2. BBAP monitoring and evaluation

On a yearly basis, an overview and analysis of progress will be produced by SWD and circulated to the relevant government departments and stakeholders. A mid-term review will be carried out at the end of 2023 (five years) by SWD with the assistance of the main stakeholders. The plan will be fully reviewed and rewritten at the end of 2028 (10 years). SWD will be assisted by the ENDANGERED SPECIES CONSERVATION UNIT that will be set up in 2019, providing that funding is obtained.

5.3. BBAP budget

Enforcement unit	RM20,000,000 for 10 years
Captive breeding	RM3,840,000 for 5 years
Endangered Species Conservation Unit	RM10,000,000 for 10 years

6) LIST OF ABBREVIATIONS

AWCSG	Asian Wild Cattle Specialist Group
BBAP	Bornean Banteng Action Plan
BORA	Borneo Rhino Alliance
BSBCC	Bornean Sun Bear Conservation Centre
CPSG	Conservation Planning Specialist Group
DaMaI	Danum Valley-Maliau Basin-Imbak Canyon
DGFC	Danau Girang Field Centre
DID	Department of Irrigation and Drainage
DVS	Department of Veterinary Services
EPD	Environment Protection Department
ESCU	Endangered Species Conservation Unit
EIA	Environmental Impact Assessment
FMU	Forest Management Unit
FR	Forest Reserves
HWW	Honorary Wildlife Warden
ITP	Industrial Tree Plantation
JKR	Jabatan Kerja Raya (Malaysian Public Works Department)
KOCP	Kinabatangan Orang-utan Conservation Programme
LEAP	Land Empowerment Animals People
MAFI	Ministry of Agriculture and Food Industries
OPP	Oil Palm Plantations
PHVA	Population and Habitat Viability Analysis
SEAARP	South East Asia Rainforest Research Partnership
SEEN	Sabah Environmental Education Network
SET	Sabah Environmental Trust
SF	Sabah Foundation
SFI	Sabah Forest Industries
SFD	Sabah Forestry Department
SFMLA	Sustainable Forest Management Licence Agreement
SLSD	Sabah Lands and Surveys Department
SP	Sabah Parks
SWD	Sabah Wildlife Department
SWHGFL	Sabah Wildlife Health, Genetic and Forensic Laboratory
UMS	Universiti Malaysia Sabah
YSD	Yayasan Sime Darby

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