



Bornean Sun Bear Action Plan for Sabah



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2025 - 2034



Sabah Wildlife Department
Ministry of Tourism, Culture and Environment

BORNEAN SUN BEAR ACTION PLAN FOR SABAH

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Front cover photo: A male Bornean sun bear photographed at the Bornean Sun Bear Conservation Centre ©BSBCC

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EXECUTIVE SUMMARY

The Bornean Sun Bear Action Plan designed for Sabah is a comprehensive document that emphasises the need for immediate, practical and adaptive conservation actions in order to ensure the long-term survival of the Bornean sun bear. This document results from an extensive consultation process initiated during the 2nd International Symposium on Sun Bear Conservation and Management.

There is limited information on sun bear's habitat use trends and distribution at a state-wide scale, and the population size is currently unknown. By pooling existing camera trap data, it was found that only half of the sun bear distribution in Sabah falls within protected areas. Sun bears are able to survive in oil palm and industrial tree plantations as long as forested areas are present. While sun bears are tolerant of certain levels of habitat degradation and modification, they show a general avoidance of humans.

Sun bear decline in Sabah is directly attributed to habitat loss and fragmentation, hunting for Traditional Chinese Medicine (bear bile), pet trade, indirect snaring and road development (such as the Pan Borneo Highway that could lead to an increase of road kills). The vision of this action plan is to secure the continued existence of a viable population of Bornean sun bears in Sabah.

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

The main objectives of this BSBAP are the following:

1. Eliminate illegal exploitation of sun bears by (a) reducing the demand for their parts and products and by (b) improving law enforcement effectiveness pertaining to hunting, trade and use of sun bears and their parts.
2. Protect and restore sun bear habitats and populations by (a) protecting priority areas of natural sun bear habitat from road and other infrastructure development and mitigate effects of existing infrastructure and by (b) prioritising sites for the conservation of sun bears and establishing conservation targets and by (c) establishing and maintaining landscape connectivity throughout the sun bear range.
3. Devise and employ methods to reliably monitor trends in sun bear populations by (a) implementing protocols for monitoring techniques that reliably detect population changes and occupancy for sun bears.
4. Maximise the contribution of ex-situ sun bear populations to conservation by (a) ensuring sun bear release initiatives adhere to internationally recognised guidelines.
5. Increase cross-sectional support and collaboration for sun bear conservation by (a) raising awareness of sun bear conservation needs and the roles that can be played by individuals, society, and the private sector and by (b) developing and supporting sun bear conservation research.

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1. INTRODUCTION

1.1 Origin and taxonomy

Helarctos malayanus (Raffles, 1821) Malayan Sun Bear

Ursus malayanus Raffles, 1821:254. Type locality “Sumatra”

Helarctos euryspilus Horsfield, 1825:221. Type locality “Borneo”

Helarctos malayanus Horsfield, 1825:234. First use of current name combination.

Helarctos annamiticus Heude, 1901:1–2. Type locality “Annam, Vietnam”

(Fitzgerald & Krausman 2002)

Sun bears are also known as “Beruang madu”, “Honey Bears,” “Dog Bears” or “Malay Bears”. Sun bears have been interchangeably assigned to their own genus “*Helarctos*” as well as to the most basal “*Ursus*” (Kitchener 2010). It is suspected that the extant sun bear could be a descendent of the bear *Ursus minimus* that roamed in the Late Pleistocene (Fitzgerald & Krausman 2002; Meijaard 2004). To date, only one species of sun bear (*Helarctos malayanus*) is recognised. As sun bears occurring on Borneo have some distinctive morphological traits, they are considered a subspecies (*H. m. euryspilus*) (Meijaard 2004). Recent phylogenetic reconstruction carried out by Kunde *et al.* (2017, 2023), and Lai *et al.* (2021,) provided further insight into the genetic variation in this species. Using mitogenomes of sun bears from Borneo, Sumatra, Cambodia, Thailand, and Peninsular Malaysia their research revealed that there are likely two distinct clades that diverged ~295,000 years ago into a “Sunda clade” (that includes bears from Borneo, Sumatra, and Peninsular Malaysia and Thailand) and a “Mainland clade” (China, Cambodia, Thailand). This research suggests that sun bears on Borneo do not have a distinctive matriline. However, the taxonomy remains unresolved until further research into nuclear loci has been conducted.

1.2 Legal status and legislation

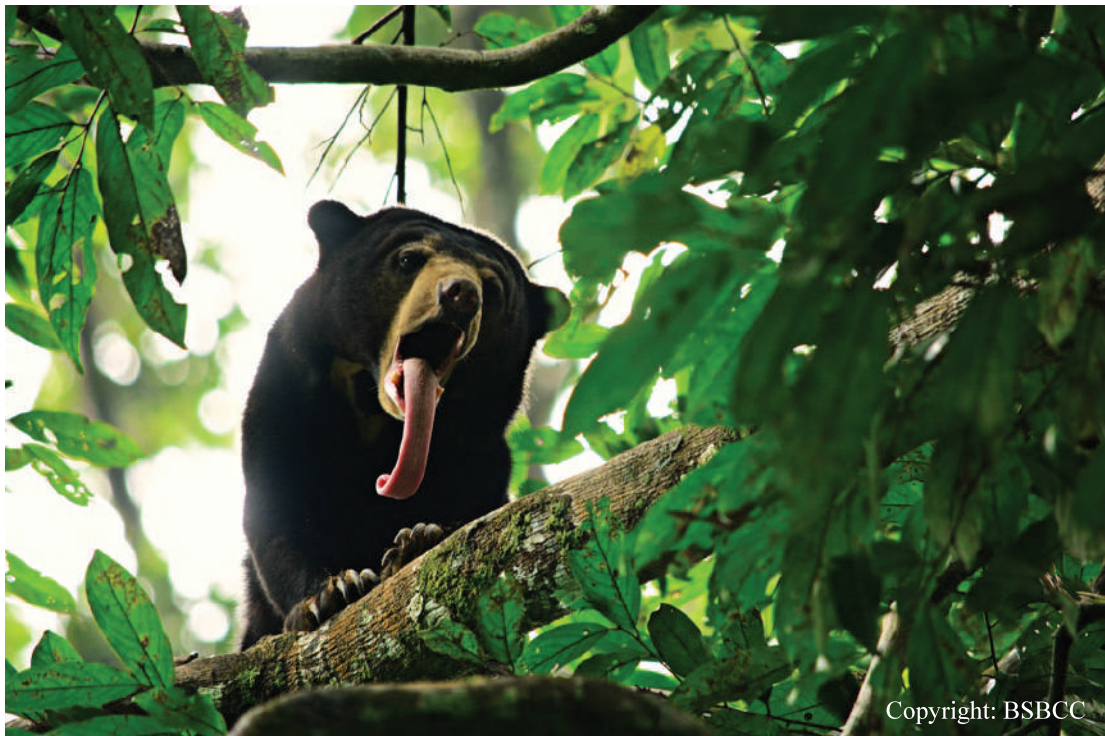
Listed as data deficient in 1995, the sun bear is now classified as vulnerable to extinction on the IUCN Red List (Scotson *et al.* 2017a) and protected under CITES Appendix I (CITES, 2022).

In Sabah, the sun bear is a Totally Protected Species under Schedule 1, Section 1 of the Sabah Wildlife Conservation Enactment (WCE) 1997. Totally protected species under Schedule 1 cannot be hunted. For those killing sun bear and/or possessing sun bear products (paws, gall bladder, skin, teeth, claws, bones and meat) and found guilty of an offence under Section 25 WCE 1997, the penalty is a minimum fine of RM50,000 and maximum of RM250,000 and imprisonment for no less than one year and up to five years.

1.3 Morphology, ecology and behaviour

1.3.1 Morphology

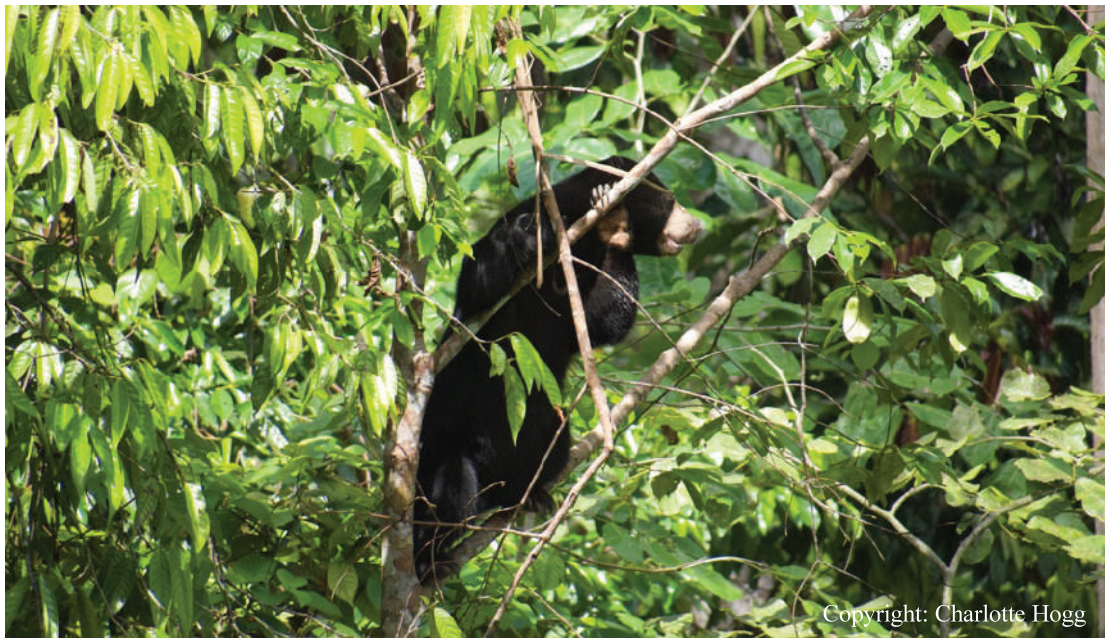
The sun bear is the smallest of the eight extant bear species. On average, an adult sun bear will measure head and body between 1m – 1.4m in length and stand at an average shoulder height of 70 cm (Fitzgerald & Krausman 2002). Their adult weight diverges between 25 and 65 kg, with males being bigger and heavier (Servheen *et al.* 1999). Sun bears on Borneo are significantly smaller in body mass than sun bears on Sumatra or the mainland of Southeast Asia (McNab 2010, Crudge *et al.* 2019). Their pelt is thick, short, and usually jet-black with a white, cream, or orange coloured ‘U shaped’ collar on its chest which is as unique to each bear as a fingerprint (Wong *et al.* 2002). Sun bear muzzles are short and show silver, grey, or orange coloration. Most sun bears will display brown patches above their eyes. These bears have round, fleshy and small ears, and a short tail (Fitzgerald & Krausman 2002). Sun bears have a stocky body shape, and large paws with naked soles and long, curled claws. The claws consist of bones and are strong enough to be used as spikes (Sasaki *et al.* 2005), allowing the bears to climb trees. These long and strong claws are also used to break into termite mounds, and tree bark when foraging for invertebrates. Another morphological adaptation that supports their arboreal lifestyle is displayed in their forelimbs which are bent facing inwards, enabling sun bears a good grip around tree trunks (Valkenburgh 1987, Sasaki *et al.* 2005). A stand-out feature for the sun bears is their extraordinarily long tongue which can stretch up to 20-30 cm. This long tongue enables sun bears to reach far deep into invertebrate nests and to access honey (Meijaard 1997), and to cool down their body during hot days (Wong pers comm.).



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1.3.2 Habitat

Sun bears are often described as a forest-dependent species as they have been negatively impacted by deforestation (Wong *et al.* 2012, Scotson *et al.* 2017a). Although these bears appear to have great adaptive potential and occupy selectively logged forests (Brodie *et al.* 2015b, Lindsell *et al.* 2015, Adila *et al.* 2017, Jati *et al.* 2018) and can survive in plantations such as oil palm and timber production plantations (Yue *et al.* 2015, Deere *et al.* 2018, Guharajan *et al.* 2018), they can only sustain themselves if forested areas are nearby. Therefore, sun bears can occupy a variety of different habitats ranging from tropical primary lowland rainforest (below 500 m, occasionally extending up to 800 m altitude) (Fredriksson *et al.* 2008), lower montane forest, hill and lowland dipterocarp forests, peat and freshwater swamps, limestone hills and degraded secondary forest (Fredriksson 2012). Despite being very adaptive regarding its habitat, sun bears do seem to generally avoid occupying habitat blocks that are near human settlement (Kunde *et al.* 2020, Guharajan *et al.* 2022).



1.3.3 Home range and activity patterns

The home range and consequent movement activity of each sun bear varies depending on food availability but can span from 7 to 27 km² (Wong *et al.* 2004, Fredriksson 2012, Cheah 2013). Sun bears are cathemeral (irregularly active at any time of the day and night); an adaptation to prevailing conditions and pressures (Wong *et al.* 2004). Even though the activity pattern of sun bears in Myanmar seems not influenced by human presence, sun bears in Borneo appear to be avoiding humans and shift their activity to hours when humans are least active (Fredriksson 2005, Cheah 2013, Guharajan *et al.* 2017, Ross *et al.* 2017).

1.3.4 Diet

Sun bears on Borneo feed mainly on figs, other forest fruits when available, invertebrates such as ants, termites, beetle larvae, as well as honey and honeycomb (Wong *et al.* 2002, Fredriksson *et al.* 2008). These opportunistic feeders will also consume human crops such as oil palm fruits, coconuts, and other fruit crop, and are therefore often described as a nuisance by local farmers (Fredriksson *et al.* 2008, Scotson *et al.* 2014, Wong *et al.* 2015). Sun bears will also predate on chicken, bird nests, hornbills (Kunde & Goossens 2021), Asian forest tortoise (Wong *et al.* 2002) and pangolins (Clements unpublished data), should the opportunity present itself. Although sun bears are naturally shy and avoid human settlements, individual bears will forage in villages (e.g., dig up termites that nest in houses as well as stingless bees, or break into the house to raid fridges and cupboards) which is giving the species a bad reputation with the impacted communities. Even though co-existence with sun bears may be challenging for the people that share their habitat with them, these bears provide important ecosystem services: due to their mostly frugivorous diet, they disperse seeds (McConkey & Galetti 1999) and when foraging for invertebrates, they are turning soil and help with nutrient mixing, maintaining trophic relationships, community dynamics and structures.



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1.3.5 Life history and reproductive behaviour

Although we know very little about wild sun bears, we know from sun bears in captivity that they can live up to 37 years if kept in good condition (Scotson & Hunt 2008) and are non-seasonal, polyoestrous breeders (Frederick *et al.* 2010). The gestation period lies between 95 - 107 days, resulting in one or two bear cubs that are born deaf, hairless, and blind. In the event of the loss/death of a cub, the sow goes into oestrus again (Schwarzenberger *et al.* 2004). Under

these circumstances, the inter-birth interval is approximately 126 ± 9 days, suggesting that there is no delayed implantation in sun bears (Fitzgerald & Krausman 2002, Schwarzenberger *et al.* 2004). The follicular and luteal phases in sun bears are typically two weeks and three months in length (Schwarzenberger *et al.* 2004). The maternal investment in sun bears is pronounced as females are often seen to cradle and carry their cubs, keeping them off the ground and sheltering them from the elements (Hall & Swaisgood 2009). The cubs will remain with their mothers until they have reached sexual maturity which is usually between two to three years (Feng & Wang 1991). Most sun bear sows produce only one or two offspring in their lifetime (Frederick *et al.* 2012).

1.4 Current distribution and population trends

Resident range states: Bangladesh; Brunei Darussalam; Cambodia; India; Indonesia; Laos; Malaysia; Myanmar; Thailand; Vietnam

Presence detected but residency uncertain: China

Extirpated: Singapore

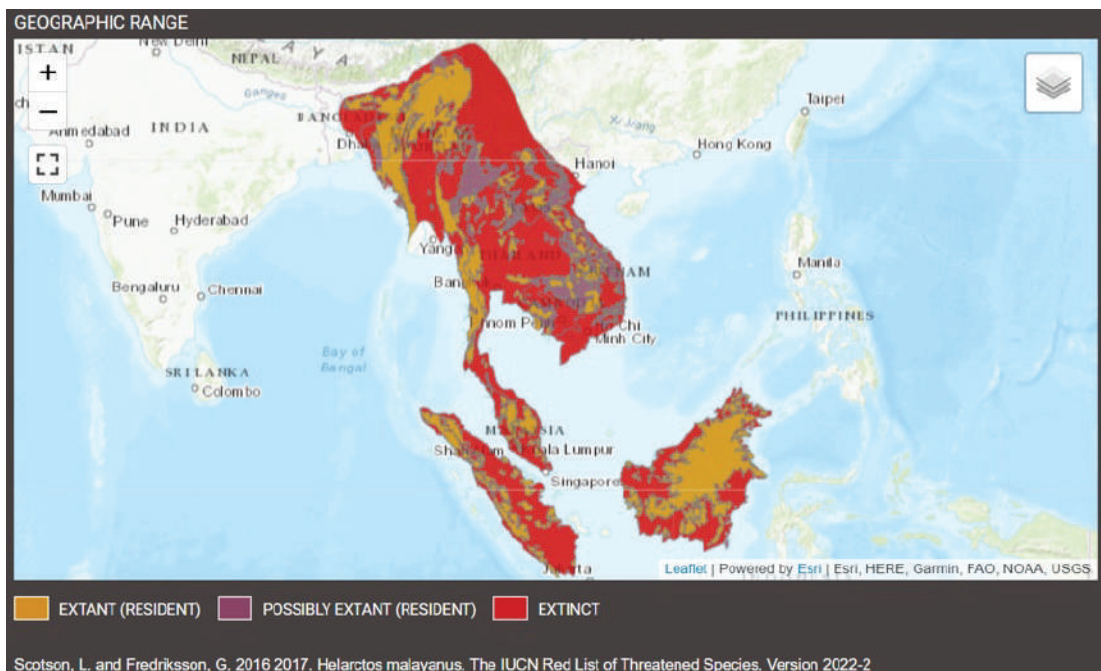


Figure 1: Sun bear distribution map. Source: Scotson, L. and Fredriksson, G. 2016 2017. *Helarctos malayanus*. The IUCN Red List of Threatened Species. Version 2022-2.

1.4.1 Sabah distribution

Sun bears are presumed to be widely distributed across the natural forests of Sabah (Guharajan *et al.* 2022). The big blocks of almost contiguous forests in south-western and central Sabah are considered a refuge for this species (Guharajan *et al.* 2022). The highlands on the west coast (Crocker Range) are also very likely important for sun bear populations. In Eastern Sabah however, suitable large areas are isolated from other forest and habitat blocks. Sun bears are deemed opportunistic with great adaptation potential. Although they have higher occupancy in

good-quality forests, this bear species has shown to be able to adapt to sudden changes to its habitat and to be able to sustain in secondary, selectively logged forest blocks (Wearn *et al.* 2017, Jati *et al.* 2018, Hwang *et al.* 2021, Guharajan *et al.* 2022). Therefore, it is possible that small pockets of forest ($\geq 1 \text{ km}^2$) could potentially have resident sun bears. However, it is unclear if sun bears could occupy a small habitat block that is isolated from other forest fragments, and if they did, how long they would be able to sustain in such a small habitat block. Nevertheless, even these small habitat fragments could provide a stepping-stone for sun bears, allowing them to travel between habitat blocks. A recently published study by Guharajan *et al.* (2022) used camera trap data occupancy models to understand habitat use patterns and predict the sun bear distribution across Sabah. This study found that sun bear was distributed in correlation to human settlement density and above-ground carbon density as these are the two main characteristics describing the quality of bear habitat. This research further eludes that only half of the sun bear distribution in Sabah falls within protected areas, drawing emphasis on the necessity to exercise thorough planning when expanding industrial tree plantations, as this almost certainly would have a big impact on sun bears (Guharajan *et al.* 2022).

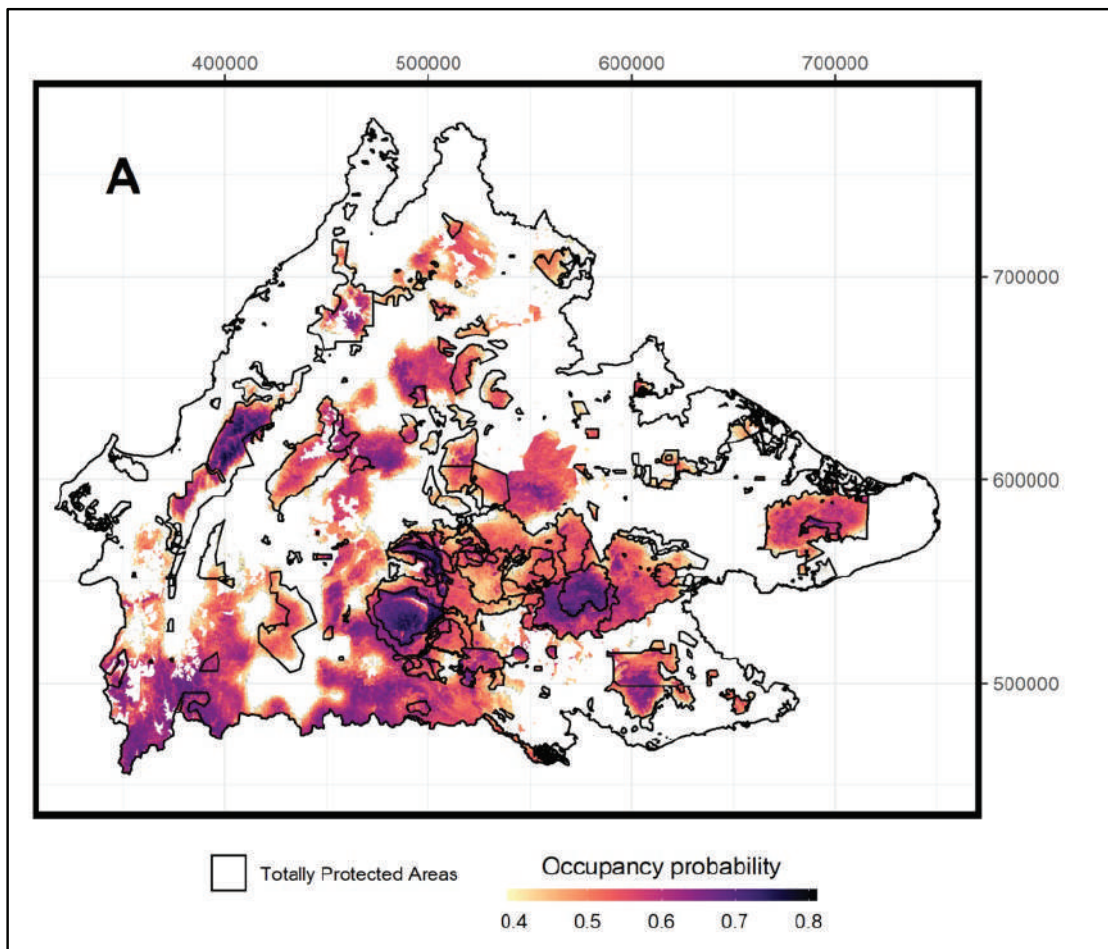


Figure 2: Predicted current distribution of the sun bear within forested areas in Sabah, excluding mangroves and areas over 1600 m elevation. Source: Guharajan *et al.* 2022.

1.4.2 Population trends

Although there are no empirical population estimates for sun bears, it is strongly assumed that sun bear populations are in decline across their entire distribution range, including Sabah, based on habitat loss and poaching incidents. This assumption has been formed by the Bear Specialist Group by estimating the population decline based on consistently high levels of exploitation, habitat loss and degradation, and the overarching diminishing geographic ranges. These factors are assumed to directly impact the population health and trend of sun bears as the more sun bear habitat is lost or converted, the more likely it is for the resident sun bear populations to decline. Therefore, it has been estimated that the sun bear population experienced a decline of approximately 35% for the past 30 years and may expect to decline around 40% or more for time periods including the future (Scotson *et al.* 2017b).

However, monitoring the wild sun bear populations effectively through systematic monitoring protocols has been inconsistent and often not feasible (Crudge *et al.* 2019). To remedy the lack of population estimates, the IUCN Bear Specialist Group reviewed various methods currently utilized to estimate population trends, such as: sign surveys, camera traps, local knowledge, visual observations, DNA-based methods, radio telemetry and expert opinion. This revision considered the reality that many sun bear research projects may vary in size and funding availability (Proctor *et al.* 2022).



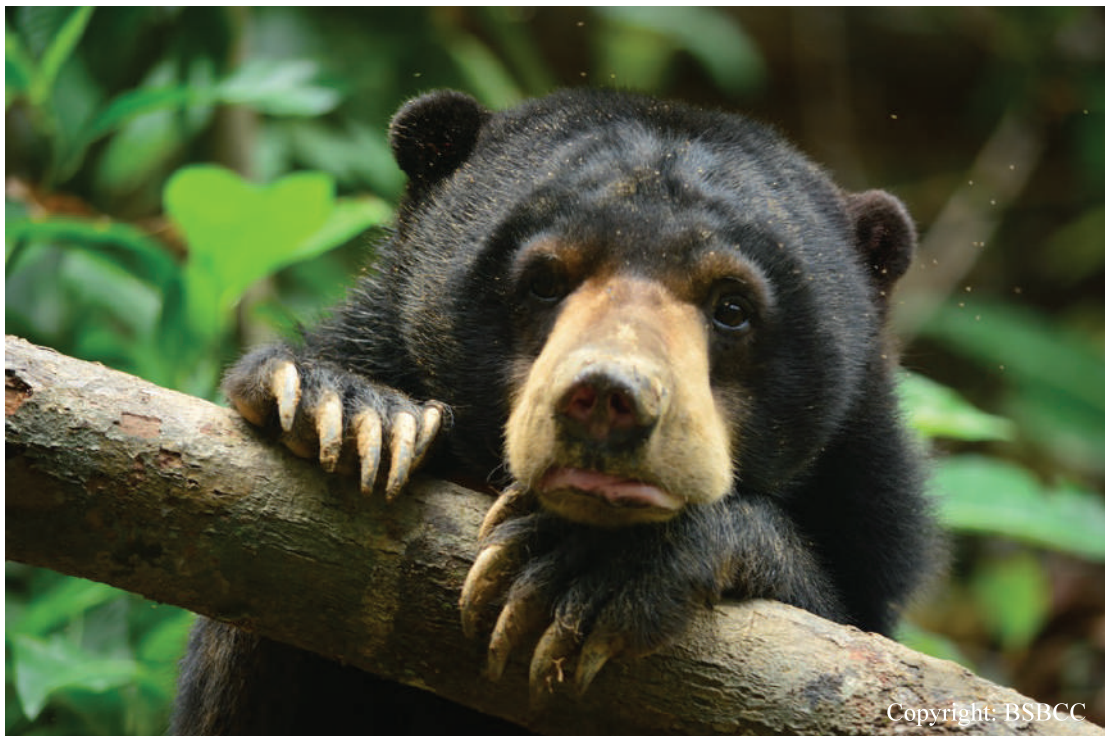
Currently in Peninsular Malaysia, the population has been estimated to 300-500 individuals (statement provided by Perhilitan in 2018). To date, there is no available sun bear population estimate for Sabah.

1.5 Threats

Sun bears face threats that can vary from each range country. For example, Vietnam may report illegal poaching as a main threat, whereas wildfire management seems most urgent in Indonesia. All range countries have listed deforestation and habitat loss and fragmentation as some of the main threats to sun bear populations worldwide. Here we discuss some of these threats with greater emphasis on sun bears in Sabah.

1.5.1 Deforestation, habitat loss and fragmentation

Deforestation in Sabah is mostly endorsed for extensive land clearing for plantations (i.e., oil palm, rubber), or for infrastructure development. Next to officially approved deforestation projects, sun bear habitat is also lost or fragmented due to illegal logging (forest encroachment by various stakeholders) and unsustainable logging practices (Wong & Linkie 2012). The rapid land conversion from natural habitat to oil palm plantations has likely had detrimental effects on this forest dependent bear species as their population size and health is associated with deforestation rates (Meijaard *et al.* 2006).



The sun bear is naturally occurring in low density, as it needs a larger home range to satisfy its energy needs. The Bornean rainforest is naturally not very productive unless the dipterocarp species are mast-fruiting. During non-mast-fruiting events, sun bears will mostly feed on figs, but will swap to a mainly insectivorous diet (Wong *et al.* 2002, Fredriksson *et al.* 2006). This means, sun bears need to cover large areas of forest to find enough food. As dipterocarp mast-fruiting events are influenced by the El Niño and La Niña events, sun bears in primary forest often go through periods of famine and sometimes even starve to death (Wong *et al.* 2002, 2005, Fredriksson *et al.* 2007). Following the drastic change of their habitat (less dipterocarp trees), sun bears need to find alternative food sources.

As mentioned above, sun bears are opportunistic feeders and have therefore been observed to adapt to the human-altered landscapes. Sun bears have been observed feeding in plantations on oil palm nuts, feeding on other fruit and acacia plantations. Camera trap pictures of sun bears around the plantations show that (when compared to bears in primary forest), these bears are quite well fed (some possibly obese) (Guharajan *et al.* unpublished data, Wai Pak *et al.* 2021). As oil palm is not a plant native in any of the sun bear range countries, it is yet unclear how a diet of this fruit would impact the health of wild sun bears. Although energy needs appear to be met, it is unclear if these bears obtain all the nutrients they require, if pesticide and herbicide used on plantations is accumulating in the body of these bears and what health consequences that may have.



Image shows a wild sun bear that was snared in Maliau Basin and venturing at the research centre. The animal was rescued by Wildlife Rescue Unit, treated and released back in Maliau. (Copyright: Diana Ramirez/WRU).

Entering plantations has the additional threat of potential zoonosis among wild bears and domesticated carnivores (such as domestic dogs frequently seen on plantations). The more the wild sun bear habitat is fragmented, the closer domesticated and wild animals come together. This not only invites potential for conflict, but also causes a sincere risk for diseases to spread throughout a region as well as from domestic to wild and from wild to domestic animals. The risk to the wild bear population through zoonosis is yet in need of further research. Finally, the threat of being shot is high when a sun bear enters a plantation.

Road development (and in particular the Pan Borneo Highway (PBH)) will have some negative environmental impact. The current PBH routing unnecessarily passes through mangroves, forest reserves (i.e. Tawai Forest Reserve in Telupid) and other protected areas, and contradicts several existing Sabah's Species Action Plans (Bornean Elephant Action Plan 2020-2029,

Bornean Banteng Action Plan 2019-2028, Proboscis Monkey Action Plan 2019-2028). The proposed Phase 3 (Kalabakan) stretch cut the head off the Heart of Borneo by dividing Sabah's most biodiverse region from the rest of the Heart of Borneo (Strategic Plan of Action (Sabah) The Heart of Borneo Initiative 2014-2020). Coalition 3H (Humans, Habitats, Highways; humanshabitatshighways.org) comprising 10 local organizations was formed as a platform for effective engagement in infrastructure development in Sabah and has proposed alternative routes and mitigation measures for selected sections of the PBH.

1.5.2 Hunting and illegal trade

In Sabah, although many oil palm estates do not allow hunting, it is still happening in plantation landscape. Although sun bears are a strictly protected species and hunting them is illegal, sun bears entering a plantation, or a human settlement maybe killed opportunistically or as a by-catch. Hunters will often place snares in plantations and in the surrounding forests to catch deer or pigs but essentially will hunt whatever animal ends in the snare. Snares are a popular, effective, cheap, and indiscriminate trapping method, and therefore posing a serious threat to most of Borneo's wildlife. Snaring is so common in the range-countries of the sun bears that most of them will have camera trap images of bears with amputated limbs. A radio-collaring project in Peninsular Malaysia reported that three out of five sun bears had missing paws, indicating that the wire-snaring hunting method is posing an imminent threat to the survival of sun bears (Cheah 2013). Bears that are snared are often killed and their body parts sold.



Although many bears may be killed opportunistically by hunters, there is an active trade in wild sun bear and bear derivatives (Foley *et al.* 2011, Burgess *et al.* 2014). Sun bears are targeted for Traditional Medicine (TM) (use of gall bladder) and food consumption. Traditionally, sun bear parts were also used in ceremonial clothing, jewelry, hunting trophies and lucky charms

(Meijaard 1999, Krishnasamy & Shepherd 2014). In Sarawak sun bear hides were used for decorative seating pads (Krishnasamy & Shepherd 2014). During the Kaamatan festival in Sabah, sun bear claws and sun bear teeth are still seen on traditional clothing, even when some of these clothes were only recently made (Kunde personal obs). Not only bear parts are traded. Sun bear cubs are in high demand for the illegal pet trade (Krishnasamy & Shepherd 2014, Krishnasamy & Stoner 2016) and often traded openly on social media platforms such as Facebook, Instagram and WhatsApp. To take a cub, hunters often kill the mother first and then sell the cub as a pet. The cubs sold as pets soon outgrow their appealing look and become more aggressive and challenging to handle in captivity. At this point, the bears are traded as food or TM products (Meijaard 2001) or surrendered to the wildlife authorities.

1.5.3 Enforcement

Although killing and trading sun bears is strictly prohibited, wildlife law enforcement is often ineffective in many countries (Shepherd & Nijman 2007, INTERPOL 2014, Livingstone & Shepherd 2014). Often wildlife crimes are not enforced, processed and or presented in court demonstrating a disregard for the severity of crimes against wildlife and nature. The low risk of being prosecuted, and the low penalty fines compared to high potential profits mean that the motivation to poach bears is likely high, fuelling the trade of bears and bear parts globally. When you pair the rapid habitat alterations, loss, habitat fragmentation, and the threats linked with direct contact between humans and sun bears (zoonosis, retaliation killing and illegal trade), it is likely too much pressure on an otherwise very adaptable and opportunistic bear species.



2. NON SITE-SPECIFIC PRIORITY ACTIONS

Goal 1: Eliminate illegal exploitation of sun bears



OBJECTIVE 1.1: Reduce demand for sun bears, their parts, and products

Rationale:

We know demand for sun bear bile and bear derivatives exists and we are assuming that this demand has negative impacts on wild sun bear populations. To develop a sustainable solution to reduce the demand for bear products, we need to understand the motivation behind bear hunting (Action 1.1.2) and bear part consumption (Action 1.1.1). Once we understand the target consumer group, we then can develop a targeted behaviour change campaign and develop a long-term monitoring project to end bear part consumption in Sabah (Action 1.1.3).

Action 1.1.1: Determine the main targets for, and design of, behaviour change and demand reduction interventions (mid-term, 1-5 years).

Action 1.1.2: Conduct research on the motivation for hunting sun bears in Sabah (mid-term, 1-5 years).

Action 1.1.3: Design, implement, monitor, and evaluate behaviour change and demand reduction interventions targeting key audiences and sources of demand (long-term, 3-10 years).

OBJECTIVE 1.2: Improve law enforcement effectiveness pertaining to hunting, trade and use of sun bears and their parts

Rationale:

Uncontrolled hunting of sun bears is considered a major threat to the survival of the species. It is illegal to hunt sun bears, and it is necessary to address this issue to improve the conservation status of the species. Insufficient implementation of wildlife laws (e.g., low penalties, insufficient regulation for trade, loopholes, etc.) continue to facilitate the illegal trade and hunting of sun bears and limit the effectiveness of law enforcement actions. Successful law enforcement requires data by which to monitor and evaluate success, and upon which to base management strategies and set targets for future interventions.

The knowledge and information on the severity of sun bear crimes has motivated law enforcement and the judiciary to strengthen convictions (higher frequency and severity of penalties imposed). At the same time, there is a need to keep documenting the extent of the illegal trade in sun bears, their parts and products that are occurring in physical and online markets to identify key traders and trade routes, and monitor trends (Actions 1.2.1, 1.2.2 & 1.2.3).

Action 1.2.1: Monitor and investigate availability of sun bear parts and products along the trade chain to enable law enforcement action (long-term, 1-10 years).

Action 1.2.2: Monitor and investigate the illegal hunting of sun bears to enable law enforcement actions (mid-term, 5 years).

Action 1.2.3: Collect baseline information (from Actions 1.2.1 & 1.2.2) to evaluate action taken to reduce hunting and trade of sun bears (long-term, 10 years).

Goal 2: Protect and restore sun bear habitats and populations



OBJECTIVE 2.1: Protect priority areas of natural sun bear habitat from road and other infrastructure development and mitigate effects of existing infrastructure

Rationale:

Infrastructure development diminishes and fragments sun bear habitat, threatening populations through habitat loss and degradation, and increasing access by poachers. Assessing the impact of such infrastructure development is imperative.

Collating information on all large-scale development projects that could negatively impact sun bear habitat in Sabah will help to identify projects with the greatest potential impact on sun bear habitat and those with the greatest potential for successful mitigation (Action 2.1.1).

Communicating with relevant donors and stakeholders regarding the effects (or potential effects) of proposed development projects on sun bear habitat may result in the incorporation of suitable mitigation measures in a development plan or may result in a reduced public or political support for a given project and/or consideration of more sustainable alternatives (Action 2.1.2).

Monitoring and evaluation of lobbying efforts will provide information on which strategies are most effective at restricting or mitigating development. This will inform future lobbying strategies to restrict development that has been assessed to negatively impact sun bears and their habitat (Action 2.1.3).

Action 2.1.1: Obtain all large-scale development plans that could impact sun bear habitat in Sabah (short-term, 1 year).

Action 2.1.2: Communicate with relevant stakeholders regarding the effects of proposed development projects on sun bear habitat and lobby stakeholders to restrict development in target areas of sun bear habitat (short-term, 2-3 years).

Action 2.1.3: Monitor and evaluate strategies for reducing impacts of infrastructure development on sun bear habitat to determine which are most effective and why (mid-term, 5 years).

OBJECTIVE 2.2: Prioritize sites for the conservation of sun bears, and establish conservation targets

Rationale:

Sun bears occur in a range of landscapes that vary in habitat quality, size, protected status, physical geography, human threats and disturbance, sun bear population density, etc.

The creation of a set of criteria that can objectively assess sites would facilitate their prioritisation for conservation, and the allocation of resources for their protection (Action 2.2.1). To make recommendations for protecting more forests for sun bears, we need to know where they are present (e.g., location as well as how many bears and bear populations are outside and how many are inside protected areas), what areas are currently (and effectively) protected, and how much of the sun bear's distribution falls within designated protected areas. A recent study by Guharajan *et al.* (2022) has investigated occupancy of sun bears across Sabah, providing good knowledge of where sun bears are present, and which habitat types and sites hold highest priority sites for sun bears. However, we would encourage more research in coastal habitat (mangroves and swamp).

As sun bears occur in habitats used by other species of high conservation priority (e.g., elephants, orangutans) in some portions of their range, sun bear conservation may benefit from the resources allocated to areas with other high priority species (e.g., in the development of anti-poaching measures), thereby freeing resources for other places important for sun bears but ignored by other conservation projects (Action 2.2.2).

Action 2.2.1: Develop criteria for the prioritization of sites in terms of importance for conservation of sun bears (short-term, 1-2 years).

Action 2.2.2: Identify portions of sun bear range overlapping with existing action plans and ongoing conservation actions for other species (short-term, 1-2 years).

OBJECTIVE 2.3: Establish and maintain landscape connectivity throughout the sun bear range

Rationale:

Small populations are more likely to become extirpated than larger ones, either due to over-hunting or to stochastic events; keeping them connected increases their likelihood of persistence, allows for genetic rescue of declining populations through immigration, and ultimately promotes long-term genetic interchange and fitness (Action 2.3.1).

Corridors connecting core areas will promote persistence of sun bears in regions where their forested habitat is fragmented. Presently, we do not know where such potential corridors are already being used by sun bears. There may exist degraded habitats, or narrow swaths of forest

being used by sun bears that could be protected and/or prevented from further degradation (Action 2.3.2).

There is also a need to monitor corridors at a smaller spatial scale to assure the inclusion and consideration of all attributes. Implementation of small-scale corridor development and monitoring projects will hopefully yield the evidence upon which to base recommendations to larger-scale projects for increasing the connectivity and the demographic resilience of sun bear populations (Action 2.3.3).

Action 2.3.1: Identify where habitat corridors are needed to connect small, isolated sun bear populations (short-term, 2 years).

Action 2.3.2: Monitor sun bear use of already existing potential corridors or degraded habitats between forest patches (mid-term, 5 years).

Action 2.3.3: Consult with stakeholders to create site-specific spatial action plans; implement small-scale corridor development; and monitor sun bear use to inform recommendations for larger-scale implementation (mid-term, 5 years).



GOAL 3: Devise and employ methods to reliably monitor trends in sun bear populations



OBJECTIVE 3.1: Implement protocols for monitoring techniques that reliably detect population changes and occupancy for sun bears

Rationale:

Population trend estimates of sun bears tend to be based on the opinions of professionals, who may consider forest loss and poaching. However, monitoring techniques using quantifiable data, such as through systematic sign and camera-trapping surveys, are becoming more common. Despite their increasing familiarity, such approaches have not been coordinated or conducted using standardised approaches across the sun bear's range. To address the need for a standardised method to survey bears in Southeast Asia, the IUCN Bear Specialist Group (BSG) held a workshop in Taiwan in 2019. The surveying and monitoring methods that have

been identified as the most reliable have been published (Proctor *et al.* 2022) and are the following: 1) interviews, 2) sign surveys, 3) camera trap studies and 4) e-DNA/genetic studies, which are useful for sun bear monitoring, as well as multi-species monitoring programs.

Southeast Asia is a global biodiversity hotspot, with several species of conservation interest throughout the sun bear's range. Studies that utilise camera traps to monitor other species, or terrestrial biodiversity in general, may also detect sun bears as by-catch. Such by-catch data has proven useful for monitoring sun bear population trends, thereby reducing the need for sun bear-specific surveys. Guharajan *et al.* (2022) demonstrated the use of sun bear by-catch data to model occupancy and identify HCV areas for sun bear conservation. Currently, there is a habitat suitability map for sun bears in Sabah. However, for a more extensive and complete sun bear habitat suitability map, we propose filling remaining survey gaps by systematically surveying forest areas in southwestern Sabah as well as mangrove forest (Action 3.1.1).

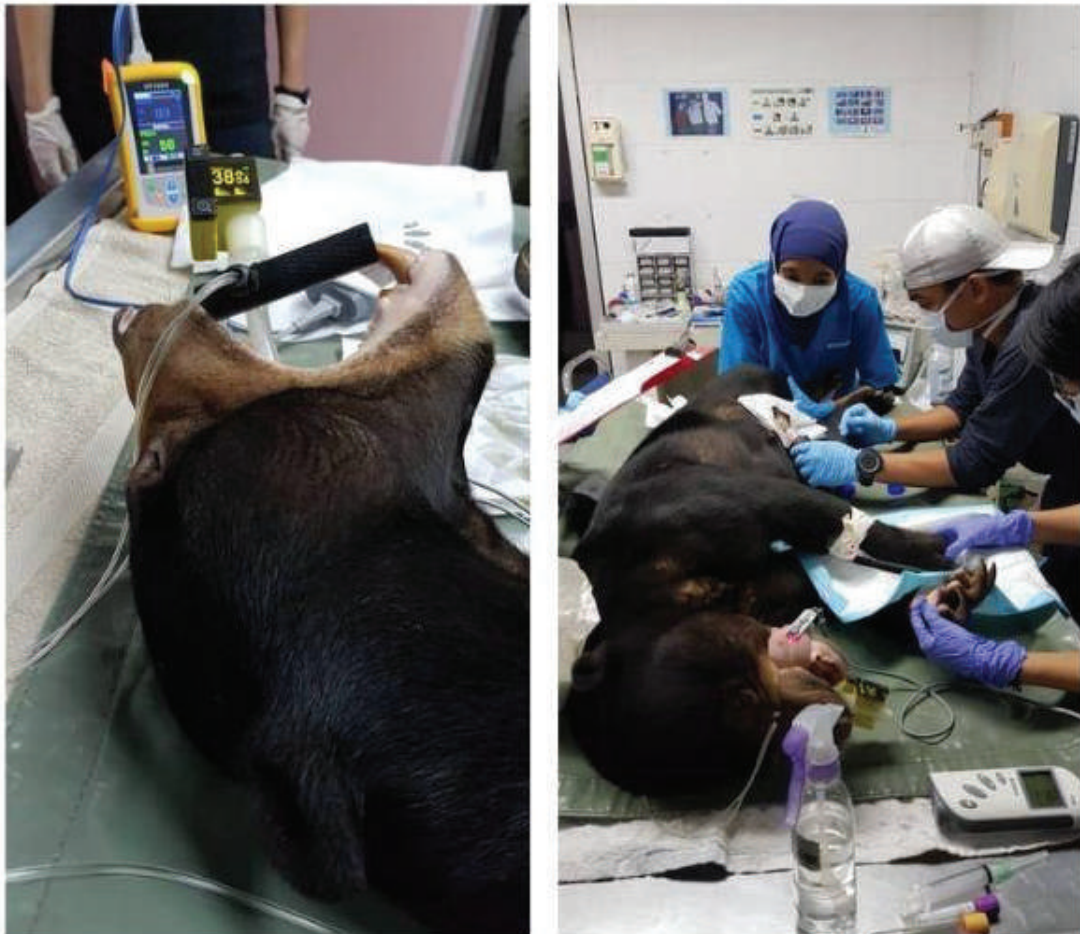
To execute a Sabah-wide sun bear monitoring program at a scale and frequency to evaluate and adapt management strategies, it will require significant in-country capacity. Assessment of this capacity for relevant government agencies, university departments, and NGOs within Sabah will allow to identify potential collaborators and training needs for the implementation of a long-term monitoring program following the standards developed by the BSG (Action 3.1.1). These long-term monitoring exercises will be pivotal to achieve clearer estimates of sun bear population trends and potential conservation actions needed.

Currently, population trends of sun bears are unknown, which limits opportunities for conservation management. Implementation of a well-designed monitoring program can help provide insights into potential conservation interventions such as wildlife law enforcement, livelihood development, as well as identify and replicate the most effective management strategies.

Action 3.1.1: Carry out additional camera trap surveys in southwestern Sabah forests and in mangrove forests to identify habitat suitability in these areas using occupancy modelling (mid-term, 5 years).

Action 3.1.2: Identify capacity and assign responsibility within Sabah to implement a monitoring program for the HCV areas identified in Goal 2 following the monitoring recommendations developed by the IUCN Bear Specialist Group (BSG) (mid-term, 5 years).

GOAL 4: Maximize the contribution of ex-situ sun bear populations to conservation



OBJECTIVE 4.1: Ensure sun bear release initiatives adhere to internationally recognized guidelines

Rationale:

Ex-situ sun bears are a valuable resource for research and are the focus of a growing number of research projects (for example (and not limited to) in areas of veterinary medicine, reproductive health and captive breeding, husbandry, and animal welfare, and for training of sign surveys).

One of the biggest sun bear ex-situ facilities is in Sabah: the Bornean Sun Bear Conservation Centre (BSBCC). The BSBCC is dedicated to sun bear rescue and release, conservation, research, education, and eco-tourism. This ex-situ facility provides suitable enclosure designs and facilities to assist with conservation relevant research. The bears that are held in the facility are almost exclusively confiscated sun bears of which several bears have been released into forested habitat in Sabah. These releases are monitored to the best of their ability through GPS

telemetry data but whether the releases have been successful or not is inconclusive at this stage. These releases might provide us with more knowledge of this secretive carnivore and are a necessary learning process to develop conservation strategies such as re-introductions or augmentations of sun bears. To maximize the data obtained and to minimize the potential threats to the wild sun bear population, we have the responsibility to review past, current, and future release efforts. We must identify research gaps relevant for sun bear release work (with emphasis on mitigating threats to the in-situ sun bear population) (Action 4.1.1), share knowledge of successes and failures of releases and work towards a standardized and openly publicized release protocol for sun bears (Action 4.1.2).

We acknowledge that sun bear releases, augmentations or re-introductions are last-resort conservation management strategies and that protecting the in-situ population must be given priority. However, translocations and release efforts might be necessary if ex-situ facilities are pushed past their carrying capacity and euthanasia is not a permissible response (culturally unacceptable or NGOs fearful of international backlash).

Action 4.1.1: Identify research gaps and research priorities to mitigate potential threats to a receiving in-situ sun bear population caused by bear translocations and rehabilitations (e.g., disease transmission, carrying capacity of release site, genetic match, etc.) (long-term project).

Action 4.1.2: Consult with the published sun bear release guidelines before each sun bear release. Review, and (if necessary) amend sun bear release guidelines after each release effort (ongoing, long-term).

GOAL 5: Increase cross-sectional support and collaboration for sun bear conservation



OBJECTIVE 5.1: Raise awareness of sun bear conservation needs and the roles that can be played by individuals, society, and the private sector

Rationale:

Industry is affecting sun bear populations, often negatively, so it is necessary to understand the motivations driving the behaviours that negatively affect sun bears. Lack of knowledge and information about sun bear conservation may be contributing to social, cultural, and personal acceptability of using bears, their parts, and products, which in turn contributes to continued poaching and trade of sun bears (Action 5.1.1).

The continued widespread and sometimes open hunting, trade and use of sun bears is, in part, enabled by societal apathy and lack of political will. Personal and social changes are required to ensure that the cruel, unsustainable, and illegal behaviours of others towards sun bears are no longer acceptable nor tolerated (Action 5.1.2).

Action 5.1.1: Engage with industry, e.g., transport sector, Traditional Medicine community, timber or forestry and plantation companies, to increase the effectiveness of sun bear conservation efforts (1 year, then ongoing).

Action 5.1.2: Engage with private sector, local communities, and social influencers to ensure the use of sun bears, their parts and products is no longer considered socially, personally, or culturally acceptable (5 years).

OBJECTIVE 5. 2: Develop and support sun bear conservation research

Rationale:

It is necessary to identify priority research projects which would contribute to the conservation of sun bears in Sabah.

Action 5.2.1: Identify and facilitate in-situ and ex-situ research projects which would contribute to sun bear conservation actions (1 year).

3. SITE SPECIFIC PRIORITY ACTIONS

Although Sabah is holding a few forest reserves that are important to sun bear conservation, many of these reserves face the same threats and require the same actions. The conservation recommendations made in this plan are aimed at these sites that are impacted by these common threats. In this section we will draw focus on sites of importance to sun bear conservation that vary with threats or Actions required. For the conservation of sun bears in Sabah, we identified two sites that require site-specific actions: Tabin Wildlife Reserve (Tabin WR) and Ulu Sungai Padas, Sungai Tagul and Pensiangan Forest Reserves.

4.1. Tabin Wildlife Reserve

Tabin Wildlife Reserve is located in eastern Sabah in the Dent Peninsula, about 50 km northeast of Lahad Datu.

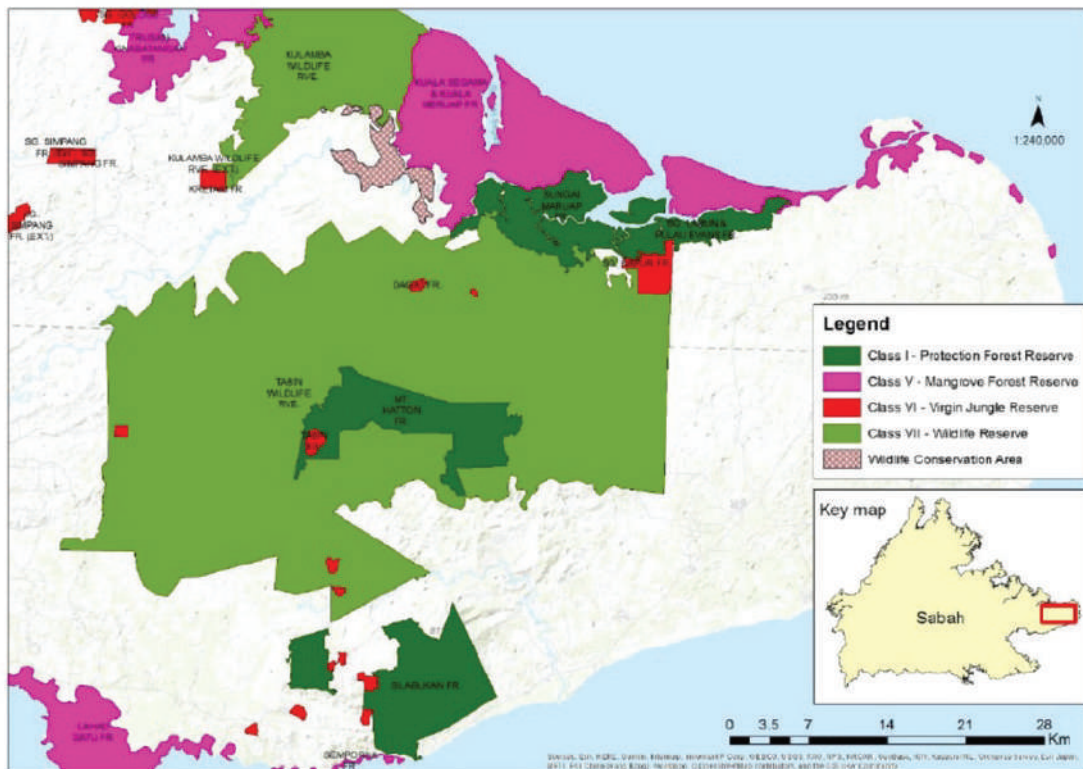


Figure 3: Map of Tabin Wildlife Reserve in Sabah, Borneo, Malaysia. Source: DGFC.

Prior to the expansion of oil palm, the majority of Tabin Wildlife Reserve (over 80% of the reserve) has been selectively logged for timber between 1969 and 1989, resulting in a mosaic of forest types at different stages of recovery. Although the reserve is relatively large, it is an isolated forest surrounded by oil palm plantations. Therefore, illegal hunting, encroachment, habitat fragmentation and human-wildlife conflicts are still occurring and threatening the biodiversity of the wildlife reserve. Tabin WR has a fragile habitat connection from its northeast border to the coastal mangrove swamps. Within the reserve are some primary forest patches that contain mud volcanoes which are important mineral and salt licks for the animal species inhabiting the forest.

Legally Tabin WR is vetted as a Class VII reserve, and therewith totally protected against logging and co-managed by the Sabah Wildlife Department (SWD) and Sabah Forestry Department (SFD).

Tabin WR has become the main site for sun bear release efforts in Sabah. The BSBCC has initiated the Tabin Sun Bear Project (TSBP) and will operate a field facility in the reserve, with the aim to expand on in-situ research for sun bear conservation and to establish a soft-release site for sun bears that have been confiscated from the illegal trade and deem suitable to be released into the wild.

Although Tabin is known for being a prime habitat for sun bears in Sabah, we do not know how many sun bears there are in these forests. We neither know the population size, genetic population structure and diversity, or the demographic of the population. The TSBP will focus on research design and execution to fill these vital research gaps as well as assist with the patrolling and combatting of poaching in the reserve.

The main threats to Tabin WR are:

- 1) Poaching (mainly on the border of the reserve)
- 2) Encroachment
- 3) Lack of connectivity to other protected areas

The main actions are the following:

Action 1: Enhance connectivity between Tabin WR, Kulamba FR, Silabukan and Central Forest and work with organisations that have been already working on this for many years such as Rhino Forest Fund and WWF-Malaysia.

Action 2: Prevent poaching by increasing coordinated enforcement and SMART patrols, especially along the core road and road bordering the plantation, as well as conducting anti-snaring operations. This is currently implemented through the setting up of the Sabah Wildlife Department's Rapid Response Teams, a team of six rangers totally dedicated to enforcement in Tabin. The team could be expanded with additional rangers and equipment/vehicles.

Action 3: Assess and monitor the sun bear population in this landscape (population status, density, and population structure). Repeat camera-trapping surveys every ~5 years to monitor the bear population and ensure population stability. This action will be implemented by BSBCC as part of their release effort through the TSBP.

Action 4: Establishment of the long-term ecological research project (south-west corner of the reserve) and rehabilitation and release effort/monitoring through the TSBP.

Action 5: Investigate the potential to develop co-management and alternative livelihoods for local communities to alleviate hunting pressure. This action will be implemented by BSBCC in collaboration with Forever Sabah and WWF-Malaysia.

Action 6: Develop a low impact eco-tourism product around sun bears by enhancing anti-poaching activities through increasing presence in the forest.

4.2. Southwest Complex (Ulu Sungai Padas, Sungai Tagul and Pensiangan Forest Reserves, Sapulut Forest Reserve)

The Southwest Complex borders with Sarawak and Indonesia, encompasses Ulu Sungai Padas FR (4°27'N/115°51'E, listed as a Class II FR) Sungai Tagul FR (4°35'N/116°09'E, also a Class II FR), Pensiangan FR (4°39'N/116°22'E, a Class I FR) and Sapulut FR (4°48'N/116°54'E to longitudes 4°32'N/116°28'E, Class II FR).

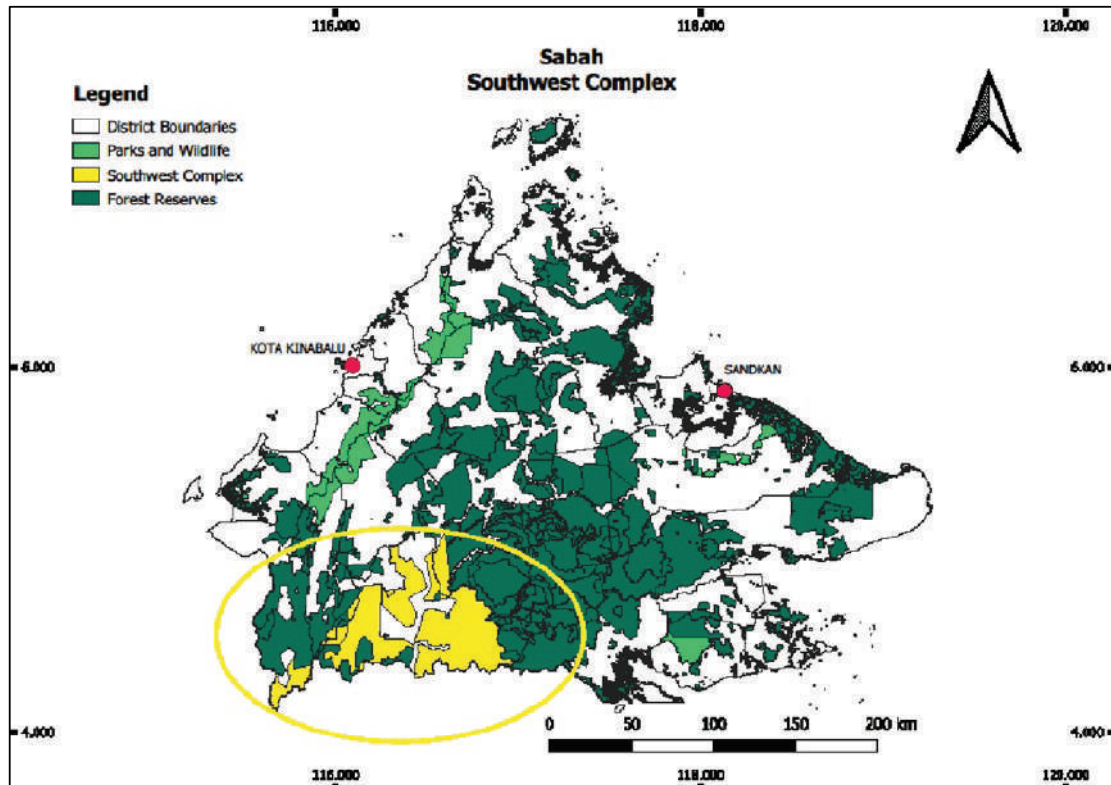


Figure 4: Map of the Southwest Forest Complex in Sabah, Borneo, Malaysia. The Southwest complex comprises of the following Forest reserves: Ulu Sungai Padas, Sungai Tagul and Pensiangan Forest Reserves, Sapulut Forest Reserve and are highlighted and circled in yellow. The map was created in QGIS 3.22.0.

Ulu Sungai consists mostly of montane forest and expands 45,690 ha. Sungai Tagul FR is covering approximately 105,770 ha. Pensiangan FR is located near the Nabawan District and expands over approximately 67,964 ha. In the early 1990s the reserve was subjected to timber extraction and is now dominated by disturbed mixed hill dipterocarp forest. These large forest reserves could be an important conservation refugia to many of Borneo's threatened wildlife. However, it seems that little to no surveying effort has been expended in the Southwest of Sabah. From the Southwest Complex, the most thorough surveys and research has been conducted in Sapulut FR (see banteng survey carried out by DGFC).

Sapulut FR, an important refuge for some of Borneo's most threatened species such as the Bornean banteng (*Bos javanicus lowi*) has a long-standing timber extraction history. Logging activities in Sapulut FR started in 1956, but most of the logging occurred in the early 1980s

(Sinoh Environmental Sdn Bhd. 2004). From 1980-2003, Sapulut FR was subjected to logging repeatedly (using conventional methods) by as many as 26 different logging operators. Logging operations were most likely not controlled or monitored as well as they should have, resulting in very poor remaining timber resources (Sinoh Environmental Sdn Bhd. 2004). Although most short-term licences expired in 2003, in 2004 Sapulut Forest Development Sdn Bhd conducted further logging activities in four coupes that then expired in 2007 (Sinoh Environmental Sdn Bhd. 2004). Logging resumed in 2014 (Prosser *et al.* 2016). During a state-wide banteng survey conducted in 2013-2014 (Gardner & Goossens 2014) the surveying team identified the following security strengths and weaknesses for the Sapulut FR.

Table 1: The security weakness and strengths of Sapulut Forest Reserve as perceived during field work conducted between 2013-2014, which threatens the protection of wildlife including the bantengs but also other game and bird species.	
Security weaknesses of Sapulut	Security strengths of Sapulut
Armed poachers enter freely into reserve using 4x4 vehicles, motorbikes and on-foot during the night and during the daytime without being apprehended. SFD staff and logging contractors also reported hunting and fishing within Sapulut. There were no stringent check points, no enforcement of the 'no hunting' policy and no anti-hunting patrols were witnessed.	Easy access to the main sealed Tawau-Nabawan highway to effect patrols and maintain contact with departments, and relatively close proximity to Maliau Basin Conservation Area reception to join forces and coordinate patrol efforts. Rangers with hunting experience may be an asset for protecting and tracking wildlife if they cease hunting activities.
Hunters regularly employ a variety of methods including firearms, snares and spear guns, and were actively removing camera traps within Sapulut Forest Reserve if found, as they claimed the land was 'their property'. The sealed highway and large area of the reserve facilitates access to the reserve.	Sabah Forest Department rangers do communicate with local villagers who apparently hunt within Sapulut, even if they have little power to control their actions, which may facilitate open discussions with the community about conserving wildlife and limiting game offtake in the future.
Poor communication between the management team of Sapulut Forest Reserve when logging activities commenced and researchers monitoring banteng, resulting in the theft of camera traps when contractors reopened logging roads and conducted logging activity.	Sabah Forestry Department have the capacity and also staff on the ground within Sapulut Forest Reserve to ensure communications are maintained with researchers actively working in the field, which may facilitate effective conservation work in a commercial forest.
Old logging roads were accessible and visible, and facilitated access by poachers. As wildlife, particularly banteng, heavily utilise logging roads for foraging, they are subject to increased human-wildlife conflict in these areas.	Logging roads provide relatively easy access when bridges are not collapsed and staff could easily patrol these on foot or establish ambushes. Could utilise a monitoring tool like SMART to strengthen and motivate wildlife patrols.
Lack of comprehensive data of illegal activity to identify poaching hotspots and patterns in hunting activity to inform enforcement and patrols within Sapulut.	Data on illegal activities may serve to inform anti-poaching patrols by departments in the future, and provide a basis for conducting further investigations over vehicular access and the activities by contractors and villagers within the reserve.

With these field observations from Sapulut, the threats for sun bears are likely similar to the threats banteng face. Therefore, critical threats include:

- 1) Potential subsistence hunting and commercial poaching.
- 2) Forest clearing and forest disturbances still underway (encroachment).
- 3) Lack of previous systematic survey that include sun bears.

To protect sun bears in the Southwest Complex we propose the following site-specific actions (SSA):

The main actions are the following:

Action 1: Identify a conservation organisation which could champion conservation actions in that region.

Action 2: Assess the status of sun bears in Ulu Sungai Padas, Sungai Tagul and Pensiangan FR (data are deficient).

Action 3: Prevent poaching by increasing coordinated enforcement and SMART patrols.

Action 4: Maintain and potentially increase connectivity between Ulu Padas, Sungai Tagul and Pensiangan FR.

Action 5: Monitoring of sun bear population in this landscape. Repeat camera-trapping surveys every ~5 years to monitor sun bear populations and ensure population stability.

Action 6: Reduce further land clearing. Expand protection status of the reserves (maybe under the 30% total protection aim by 2025).

Action 7: Assess the potential impact of the Pan Borneo Highway on landscape connectivity for sun bears and maintain connectivity with central Sabah through the setting up of underpasses/overpasses.

Additional protected areas with similar threats and similar actions should be considered:

Trus Madi, Ulu Sungai Milian and Ulu Tungud Forest Reserves, Kinabalu Park, Crocker Range, Paitan, Sugut, Lingkabau and Bengkoka Forest Reserves.

Finally, connectivity could be re-established in the Lower Kinabatangan Wildlife Sanctuary by building an Eco-bridge above the planned PBH segment, linking the two sections of the Pin Supu FR. It is also important to keep preventing the building of a second bridge in Sukau.

4. IMPLEMENTATION, MONITORING, EVALUATION AND BUDGET

SBAP implementation

This is a 10-year action plan (2025-2034). For this plan to achieve its ultimate objective of securing the future of the sun bear in Sabah, all recommendations should be evaluated by SWD and endorsed by the Sabah State Cabinet.

The implementation of the SBAP remains the responsibility of SWD. However, assistance from other relevant departments such as SFD, SF and SP will be provided, as well as assistance from the BSBCC. For this purpose, BSBCC will set up a Sun Bear Conservation Unit and hire an action plan coordinator who will assist SWD in the monitoring of the implementation of the plan.

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

SBAP monitoring and evaluation

On a yearly basis, an overview and analysis of progress will be produced by SWD with the assistance of the action plan officer from BSBCC and circulated to the relevant government departments and stakeholders. A mid-term review will be carried out at the end of 2029 (five years) by SWD with the assistance of BSBCC and other stakeholders. The plan will be fully reviewed and rewritten (if necessary) at the end of 2034 (10 years).

SBAP budget

Component	Duration	Cost (per year)	Cost (total)
State-wide sun bear survey	3 years	RM 500,000	RM 1,500,000
Population monitoring	7 years	RM 250,000	RM 1,750,000
Education/outreach programme	10 years	RM 150,000	RM 1,500,000

5. LIST OF ABBREVIATIONS

BSBCC	Bornean Sun Bear Conservation Centre
BSG	Bear Specialist Group
CIFOR	Centre for International Forest Research
CITES	Convention on International Trade in Endangered Species
CMR	Capture Mark Recapture
Coalition 3H	Coalition Humans Habitats Highways
DGFC	Danau Girang Field Centre
DID	Department of Irrigation and Drainage
EAZA	European Association of Zoos and Aquariums
EPD	Environmental Protection Department
FCPMDAM	Federation of Chinese Physicians and Medicine-Dealers Association of Malaysia
IU	Intelligence Unit
IUCN	International Union for the Conservation of Nature
IZW	Institute for Zoo and Wildlife Research
JAZA	Japanese Association of Zoos and Aquariums
JKR	Jabatan Kerja Raya
LEAP	Land Empowerment Animals People
MAFFI	Menteri Kementerian Pertanian, Perikanan dan Industri Makanan Sabah
MPOC	Malaysian Palm Oil Council
NGO	Nongovernmental Organization
PBH	Pan Borneo Highway
PERHILITAN	Jabatan Perlindungan Hidupan Liar dan Taman Negara Semenanjung Malaysia
RFF	Rhino Forest Fund
RSPO	Roundtable on Sustainable Palm Oil
SaBC	Sabah Biodiversity Council
SEAARP	South East Asia Rainforest Research Partnership

SET	Sabah Environmental Trust
SF	Sabah Foundation
SFD	Sabah Forestry Department
SLSD	Sabah Lands and Surveys Department
SMART	Spatial Monitoring and Reporting Tool
SP	Sabah Parks
SWD	Sabah Wildlife Department
TCM	Traditional Chinese Medicine
TM	Traditional Medicine
TSBP	Tabin Sun Bear Project
UMS	Universiti Malaysia Sabah
WCE	Wildlife Conservation Enactment
WWF	World Wildlife Fund

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ANNEX 1. RESOURCES AVAILABLE AND NOT AVAILABLE, MEASURES TO BE TAKEN, SUCCESS MEASURES

Goal 1. Eliminate illegal exploitation of sun bears

Objective 1.1. Reduce demand for sun bears, their parts, and products

Resources available:

1. Expertise (WWF Malaysia, TRAFFIC Southeast Asia, Free the Bears).
2. Tools/methods for conducting consumer behaviour or demand research.
3. Tools/methods to conduct research on hunting motivation.
4. In-country capacity (BSBCC).
5. TRAFFIC 2016 report as baseline data.
6. Sabah Wildlife Department's Intelligence Unit (IU).

Resources NOT available:

1. Funding.
2. Human Behaviour Change (HBC) baseline data to monitor and evaluate.
3. Knowledge on how to change behaviour in local communities.
4. Past and current information on key areas where sun bears are hunted.
5. Information on the extent to which poaching is resulting in sun bear population decline.

Measures to be taken:

1. Secure funding.
2. Conduct surveys and analyse data (SWD's IU).
3. Identify target group (consumer) in Sabah (SWD's IU).
4. Identify restaurants and illegal sun bear markets and travel operators offering exotic meat (SWD's IU).
5. Draw from Action 1.1.1 for obtaining the baseline data for consumer behaviour (Action 1.1.2).
6. Design behaviour change campaigns to reduce illegal hunting, targeting the key audience (Action 1.1.2).
7. Monitor the consumption of bear products by monitoring local restaurants and TCM shops to see if the consumer trend is decreasing or not (Action 1.1.2) (SWD's IU).
8. Submit research results in peer reviewed paper or in a report format.
9. Set up the Endangered Species Conservation Unit.

Success measures:

1. Funding is secured.
2. Surveys have been completed.
3. A comprehensive report has been written.
4. Interventions have been initiated and all key consumer markets identified.
5. Significant reduction of bear consumption.

Lead agencies: SWD, BSBCC, TRAFFIC, UNIVERSITIES

Partners: DGFC, FTB, INTERPOL

Objective 1.2. Improve law enforcement effectiveness pertaining to hunting, trade and use of sun bears and their parts

Resources available:

1. Some information on where hunting is taking place (by using camera trap data showing evidence of snare injuries to wildlife in protected and non-protected areas).
2. SMART conservation software.
3. Existing patrolling/surveillance tactics and teams (e.g., techniques developed by Panthera/Freeland for site security).
4. Expertise (TRAFFIC).
5. Current undercover operations in Sabah (SWD's IU).
6. Critical Conservation Landscapes from the Forest Research Centre.
7. National and regional law enforcement agencies information (SWD, SFD, Malaysia Maritime Enforcement Agency, Police).
8. PROTECT baseline data on hunting in FRs, WRs, WS.
9. Rapid Response Teams (anti-poaching teams) established by SWD in Lower Kinabatangan Wildlife Sanctuary and Tabin Wildlife Reserve.
10. Sabah Wildlife Department's Intelligence Unit.

Resources NOT available:

1. Additional funding, manpower and equipment

2. Baseline information from Actions 1.2.1 and 1.2.2

Measures to be taken:

1. Monitor the illegal trade in Sabah through intelligence-gathering.
2. Analyse data and write annual reports, mid-term reviews.
3. Improve forensic analysis methods (Action 2.5 of the regional action plan)
4. Identify and prosecute the whole chain of the trade: from poacher to distributor (e.g., restaurants, tour operators) to consumers.
5. Develop a campaign to incentivize TCM practitioners/shops to phase out bear derivatives as medicine.

Success measures:

1. Funding has been secured.
2. Investigations have been conducted.
3. The intelligence unit has compiled a report on the trade.
4. Arrests have been made.
5. Offenders have been prosecuted.
6. Bear bile demand for TCM has decreased.
7. Monitoring has been/is conducted.
8. Reports are published annually.

Lead agency: SWD

Partners: SFD, BSBCC, TRAFFIC, DGFC

Goal 2. Protect and restore sun bear habitats and populations

Objective 2.1. Protect priority areas of natural sun bear habitat from road and other infrastructure development and mitigate effects of existing infrastructure

Resources available:

1. Road assessment and recommendations for mitigation for some areas of Sabah (e.g., work carried out by Humans, Habitats, Highways (3H) coalition on the Pan Borneo Highway (PBH); see also work by James Cook University in relation to the PBH and other roads and infrastructure development).
2. Threat assessment for proposed roads in SE Asia (7 countries), based on threat to large mammals (in general, not bear specific) (Clements *et al.* 2014).
3. Publications about road and infrastructure plans from World Bank and Asian Development Bank.
4. Other species of conservation importance (e.g., Sunda clouded leopard, Bornean elephant, Bornean banteng) sharing habitat with sun bears, with which to leverage further support.
5. Some studies on the efficacy of mitigation measures (e.g., road signs as a deterrent to encroachment: Mahfuzatul Izyan, University Malaysia Terengganu).
6. Documentation of all current and planned major infrastructure projects that may affect forested habitats in sun bear range (Sabah Structure Plan).
7. List of priority areas for the protection of natural sun bear habitat (Objective 2.7) (see Guharajan *et al.* 2022).

Resources NOT available:

1. Connection to existing networks and institutions working on advocacy regarding infrastructure and roads (e.g., ALERT Network at University of Queensland).
2. A process to engage policymakers.
3. Links between policies at the national and regional scale.
4. Evaluation of effectiveness of varying strategies and tactics as part of previous ‘lobbying’ efforts to curtail infrastructure.
5. Assessment of the effectiveness of various mitigation measures in other regions such as Peninsular Malaysia.

Measures to be taken:

1. Assign dedicated person to collate and synthesize all information on current and planned development projects (Sun Bear Conservation Unit within BSBCC).
2. Compare and evaluate planning projects with sun bear distribution maps to identify sun bear populations at risk and assess how these planning projects may impact sun bear populations (Action 2.4.1 completed).
3. Identify appropriate case studies and suitable monitoring methods.
4. Assess the efficacy and efficiency of different strategies and their potential for broader applications.
5. Negotiate and consult with stakeholders and developers.
6. Compile results in a report.

Success measures:

1. Sun Bear Conservation Unit has been set up.
2. Existing networks to complete Actions 2.1.1, 2.1.2 and 2.1.3 have been identified.

3. Information regarding sun bear conservation status and needs have been provided to relevant institutions (compiled, synthesized, and assessed).
4. Mitigation measures have been incorporated into development plans.
5. Potentially destructive development projects are avoided (via lobbying and presentation of alternative development strategies).
6. Compilation of results from previous lobbying experiences has been completed.
7. Consultation strategy for stakeholders and developers has been developed.
8. A report presenting the findings has been publicized.

Lead agencies: SWD, SFD, Yayasan Sabah, JKR

Partners: Coalition 3H (BSBCC in particular)

Objective 2.2. Prioritise sites for the conservation of sun bears, and establish conservation targets

Resources available:

1. Habitat suitability map for sun bears (Guharajan *et al.* 2022).
2. The Wildlife Atlas of Sabah project also has data of sun bears from camera traps and wildlife surveys from various researchers (Guharajan & Wong 2022).
3. General range map for sun bears, some site-based assessments of sun bear population status.
4. Information available on the size, location, and status of protected areas (www.protectedplanet.net; opendevelopmentcambodia.net/)
5. Some information on habitat quality (especially for protected areas and forest reserves).
6. A sun bear population study conducted in Cambodia as study reference.
7. Some existing information on threats (logging/land conversion, conversion to plantations, small populations fragmented poaching (e.g., Deere *et al.* 2020).
8. Existing information about current levels of habitat protection.
9. Knowledge of responsible parties regarding enforcement.
10. Existing action plans for other species.
11. Ongoing conservation actions directed at other species within the range of sun bears.
12. HCV map from the FRC group.

Resources NOT available:

1. Information on the status of individual sun bear populations.
2. Information on threats impacting individual sun bear populations.
3. An understanding of habitat connectivity (Objective 2.3).
4. Information on how habitat quality impacts sun bear populations.
5. More site-based assessments of sun bear populations.
6. Protocols for setting priorities to conserve sun bears.
7. Dedicated person to collate available data.

Measures to be taken:

1. Assign staff from the BSBCC's Sun Bear Conservation Unit to collate information.
2. Compare actions proposed in the other species action plans (e.g., proboscis monkey, Sunda clouded leopard, Bornean elephant, Bornean orangutan, and Bornean banteng) and contrast the range of these target species with known sun bear range in Sabah (e.g., prepare one map with the protected areas for the five other species covered through action plans and identify which area is not covered for sun bears).
3. Conduct research to provide baseline data on the status of sun bear populations, threats, habitat connectivity among populations (e.g., through landscape genetic studies, and/or multi-scale corridor identification and spatial analysis), habitat quality assessments, and site-specific ecological assessments.
4. Identify the most valuable habitat for sun bears and the threats it is facing.

Success measures:

1. Funding has been secured.
2. Comparison of action plans has been conducted.
3. A map has been produced that overlaps the protected areas from the existing species action plans.
4. Completion of site-based assessments and achievement of research objectives.
5. Site-specific actions have been identified.
6. Criteria to prioritize sites of importance for conservation of sun bears have been developed.
7. Criteria are effectively applied across the sun bear range.

Lead agencies: SWD, SFD, BSBCC

Partners: WWF-Malaysia, DGFC (conservation planning officer), research community/experts

Objective 2.3. Establish and maintain landscape connectivity throughout the sun bear range

Resources available:

1. RSPO open-source HCV forest map
2. LiDAR and Landsat data.
3. A few studies of sun bear habitat patches (e.g., Nazeri *et al.* 2012 in Peninsular Malaysia).
4. Studies of other bear species demonstrated corridor use and functional connectivity among core areas (e.g., Mohammadi *et al.* 2021, Morovati *et al.* 2020, Doko *et al.* 2011).
5. Studies of other species (e.g., Bornean elephant, Sunda clouded leopard and Bornean banteng in Sabah (Brodie *et al.* 2015, Evans *et al.* 2018, Hearn *et al.* 2019, Lim *et al.* 2019). Evaluating multispecies landscape connectivity.
6. Existing methodologies and tools (e.g., Linkage Mapper).
7. General knowledge of habitats used by sun bears (from sign surveys, camera trapping and ecological studies).
8. Existing data from camera trapping on occurrence of sun bears in Sabah.
9. Corridor construction from Tabin to Kulamba and Tabin to Silabukan (initiative of the IZW and RFF).
10. WWF plantation restoration project creating a 100ha corridor to connect Tabin and Silabukan.
11. Information on wildlife corridor efforts already initiated for other species (e.g., elephants).
12. Maps and publications on sun bear populations in Sabah.
13. Research on suitable habitat for sun bears, and habitat priority areas (Guharajan *et al.* 2022).
14. FRC priority landscapes.

Resources NOT available:

1. Compilation and synthesis of lessons learned from other corridor projects in the region (e.g., Kinabatangan area in Sabah; Pench corridor in India (Dhamorikar *et al.* 2017, Dutta *et al.* 2016, 2018); Terai community forest corridors in Nepal (Thapa *et al.* 2017).
2. Compilation and synthesis of existing data to assess evidence of sun bear use of areas (plus results of Action 2.7.1).
3. Genetic research to examine connectivity of sun bear populations.
4. Consensus approach to prioritize the designation of corridors most important to sun bears.
5. Communication with/presentations for government authorities about potential importance of habitat corridors to sun bear viability.

Measures to be taken:

1. Identify an ‘Action plan coordinator’ within the BSBCC’s Sun Bear Conservation Unit to collect data and maps.
2. Provide staff with data and connections to stakeholders, NGOs, and researchers with available data (e.g., establish collaboration with FRC, line up action plans with FRC priority landscapes, develop protection and monitoring plan).
3. Compile results from Objective 2.7 to identify and prioritize where wildlife corridors should be developed, or if already established, which corridors deserve stricter protection measures based on sun bear population status (population size/composition), threats, conservation value, feasibility, severity of fragmentation status.
4. Create a map with proposed corridors between existing sun bear populations (Action 2.6.1).
5. Approach plantation management for existing camera trap data.
6. Arrange workshops with plantation managers on camera trap studies and camera trap standards.
7. Collaborate with stakeholders and targeted communities to conduct “small corridor experiments” whereby the efficacy of habitat connectivity is tested as a partnership.
8. Further utilize occupancy data (camera-trap data) to monitor sun bear populations.
9. Continued attempt to GPS tracking wild sun bears to understand their spatial movements through the corridors.
10. Compile findings in peer-reviewed publications and in a comprehensive report to relevant governmental bodies.

Success measures:

1. Sun Bear Conservation Unit has been set up and ‘Action plan coordinator’ has been assigned.
2. Collaborations have been established.
3. 1-2 corridor projects have been initiated.
4. Camera-trap workshops have been held in plantations.
5. Spatially explicit capture-recapture (SECR) camera-trap based projects have been established, or those using a similar level of robustness.
6. Priority corridors have been identified.
7. A map has been produced with proposed corridors for sun bears.

8. A written report has been submitted to the government.
9. Findings have been made public as part of a media friendly outreach program.

Lead agencies: SFD, SWD, Universities, Industry, BSBCC

Partners: NGOs, Rhino and Forest Fund, BSBCC, DGFC

Goal 3. Devise and employ methods to reliably monitor trends in sun bear populations

Objective 3.1. Implement protocols for monitoring techniques that reliably detect population changes and occupancy for sun bears

Action 3.1.1. Additional systematic camera trap surveys in southwestern Sabah forests and in mangrove forests to identify habitat suitability in these areas using occupancy modelling

Resources available:

1. A few existing studies about sun bear habitat use, behaviour, and feeding ecology, within different types of forests and at forest-plantation edges (Wong *et al.* 2002, 2004, Guharajan *et al.* 2018, Wai Pak *et al.* 2021).
2. Some existing information, some on-going studies, and some field-tested techniques for assessing habitat quality.
3. Study (Guharajan *et al.* 2022) using occupancy for assessing preferred habitat types in dipterocarp forest environments (*the study which should be replicated in the remaining habitat types*).

Resources NOT available:

1. A clear definition of “high quality sun bear habitat”.
2. Lack of long-term field projects to understand demographic effects of different habitats and habitat components.
3. A network of people to conduct studies over broad areas with varying conditions.
4. Systematic surveys of mangrove forests.
5. Systematic surveys of southwestern Sabah forests.

Measures to be taken:

1. Set up a network of Sabah organisations that are carrying out camera trapping work (BSBCC, DGFC, HUTAN, WildCRU, Panthera).
2. Hire a researcher and set up a small research/survey team as part of BSBCC.
3. Compile sun bear database with published and unpublished data.
4. Establish a camera trap database (electronic) at SaBC or SFD and establish a data-management protocol to be followed by SaBC or SFD staff.
5. Assign SaBC to be the depository for camera trap data or to collect species information in report format (standardized format) and recruit a responsible data-manager.
6. Enforce the requirement for researchers to submit by-catch data (published and unpublished).
7. Promote a camera trap standard across researching parties.
8. Discuss methods that should be applied (e.g., capture-mark-recapture (CMR)).
9. Identify researchers (network) and study sites (e.g., BSBCC to identify 5-10 critical sites to establish long-term monitoring).
10. Apply for funding for the setting up of the research team that will be under BSBCC.
11. Conduct research.
12. Produce report and scientific publication.

Success measures:

1. Dedicated staff/research team has been assigned.
2. Review paper on what is known about sun bear habitat quality in different parts of the range.
3. Establishment of a digital repository at SaBC for camera trap data.
4. Compile camera trap data from plantations near protected areas.
5. The development of a sun bear database.
6. Long term field projects have been implemented.
7. Papers on sun bear habitat use have been published.
8. Recommendations for high quality sun bear habitats have been published.
9. Annual progress reports have been published.

Lead agencies: BSBCC, SaBC

Partners: SWD, SFD, SB, SP, DGFC, Panthera, HUTAN, WildCRU, plantation managers, sun bear researcher community

Action 3.1.2. Identify capacity and assign responsibility within Sabah to implement a monitoring programme for the HCV areas identified in Goal 2

Resources available:

1. Numerous field projects in the region using various monitoring techniques, some using multiple techniques on the same area (e.g., camera trap surveys with and without individual identification of bears, bear sign surveys, interview-based surveys, collection of DNA from hair or scats).
2. Remote-sensing data; forest loss data.
3. Surveys of expert opinion of changes in sun bear populations.
4. In country people with expertise in various types of survey methodology (local interviews, sign surveys, camera trapping, DNA, remote sensing).
5. IUCN Red List Assessment range map with Extant and Probably Extant populations.
6. Map identifying sun bear habitat suitability in Sabah (Guharajan *et al.* 2022).
7. Expert opinions on key monitoring areas, based on poaching or habitat issues.
8. Understanding of what constitutes high quality sun bear habitat, and how various habitat components affect sun bear populations for dipterocarp forests (Objective 2.6).
9. FRC landscapes (and forest connectivity maps/plans)
10. Sabah Structure Plan (identifying areas that will be impacted by future development and infrastructure planning).
11. Standard to monitor Asian Bear species developed by the BSG (Proctor *et al.* 2022).

Resources NOT available:

1. Dedicated person to compile available data for Sabah.
2. Dedicated project lead that is skilled in systematic study design and quantitative methods for estimating certain demographic parameters (i.e., occupancy, density)
3. A complete understanding of what constitutes high quality sun bear habitat, and how various habitat components affect sun bear populations for mangroves, swamp, coastal habitat (Objective 2.6).
4. Criteria for choosing and prioritizing monitoring sites (Action 2.7.2).
5. List of priority sites important for monitoring bear population trends (Actions 2.7.2 and 3.2.1, recommended use of FRC landscapes).
6. New partnerships with potential for long-term site-based monitoring.
7. Training workshops (e.g., for long term camera trap projects) to build lasting capacity in Sabah (Action 3.3.2).

Measures to be taken:

1. Assign dedicated person and field staff.
2. Apply for funding for salaries, analysis of collated data, and samples.
3. Provide data from Objective 2.6 to the dedicated person.
4. Identify survey zones (FRC zones).
5. Identify local monitoring teams and provide training in survey techniques.
6. Identify critical conservation landscapes where bear populations are low /bear populations are of conservation concern.
7. Consult fellow scientists and sun bear experts for feedback on the results.
8. Establish and maintain a long-term monitoring project for sites of conservation concern (this may require application for funding).
9. Review method and preliminary data after one year.
10. Submit amendments to funding organizations and the research community.
11. Conduct the monitoring of the Sabah population.
12. Compile findings in a grey and white literature.

Success measures:

1. Staff has been assigned.
2. Funding has been secured.
3. Local monitoring staff has been trained in surveying techniques/data analysis.
4. Most relevant available data have been compiled and examined.
5. Key areas have been identified throughout the sun bear range in Sabah.
6. A 5-year report.
7. Report on method amendments, research findings, populations at risk, and population trends in a peer reviewed journal.
8. Annual project report to funders and stakeholders has been submitted (project status and preliminary findings).

9. A long-term monitoring plan is in place.

Lead agencies: BSBCC

Partners: SWD, SFD, Relevant NGOs/agencies (e.g., WWF), Universities, DGFC

Goal 4. Maximise the contribution of ex-situ sun bear populations to conservation.

Objective 4.1. Ensure sun bear release initiatives adhere to internationally recognised guidelines.

Resources available:

1. Ex-situ sun bear population (BSBCC).
2. Documented previous experience with sun bear release.
3. Existing IUCN Guidelines for reintroduction and guidelines for the release of other species.
4. Release guidelines from PERHILITAN (Abidin *et al.* 2021).
5. BSBCC's GPS collar data from released bears.

Resources NOT available:

1. Guidelines and results for releases from all facilities which have released sun bears.
2. Relevant research into crucial disciplines and subjects such as sun bear health, suitable release sites, natural behaviour, and population genetics.
3. English edition of the Release guidelines from PERHILITAN.
4. Published information on disease risks.
5. Methods for determining the impact of sun bear release on conservation (Action 4.1.1).

Measures to be taken:

1. Assign dedicated person(s): BSBCC staff.
2. Assist with collecting information on released bears, the release method, health, and genetic screening documentation, behavioural assessment and training, spatial ecological data, threat elimination/management, monitoring and assessment of the receiving population.
3. Identify current release strategies and compare them to recommendations made by the IUCN Reintroduction Specialist Group.
4. Identify research topics of reintroduction and rehabilitation importance.
5. Continue the collaboration between BSBCC and EcoHealth Alliance on past and future research projects (with emphasis on potential disease spread from released bears into the in-situ bear population).
6. Assess "cost-benefit" of release/rehabilitation as a conservation tool.
7. Define rehabilitation success (e.g., what accounts as a successful rehabilitation to the wild? Dispersal? Survival of one year? Genetic contribution to the wild population?).
8. Compile and publish all findings in an internal report.
9. Utilise report from Action 4.1.1 to identify research gaps and to compile rehabilitation guidelines.
10. Publish the guidelines and promote the use of the guidelines by all facilities involved in rehabilitation.

Success measures:

1. Dedicated staff has been assigned.
2. The successes, failures and impacts of sun bear releases have been and are being documented.
3. Research gaps to study the impact on a receiving population have been identified.
4. Research to mitigate threats to the receiving sun bear population is carried out.
5. Guidelines are produced and published.

Lead agencies: BSBCC, SWD

Partners: BSG, DGFC, PERHILITAN

Goal 5. Increase cross-sectional support and collaboration for sun bear conservation.

Objective 5.1. Raise awareness of sun bear conservation needs and the roles that can be played by individuals, society, and the private sector.

Resources available:

1. Forestry Companies and Plantation outreach.
2. Willingness of the FCPMDAM to support wildlife crime enforcement.
3. Experience with industry (e.g., TM practitioners, courier, delivery and forwarding companies, plantations) workshops (TRAFFIC, WWF).
4. Baseline data from Vietnam about TM practitioner beliefs and behaviours.
5. Outreach programs (BSBCC, SWD).
6. First trial in religious outreach by WWF.
7. Rescue centre as platform.
8. Partnerships with private sectors and social influencers.
9. Information to justify communication message.

10. Endangered Species Conservation Unit.

Resources NOT available:

1. Links with the SEAZA and range-state sanctuaries/ rescue centres.
2. Closer collaboration between organizations (e.g., BSBCC and TRAFFIC to work with FCPMDAM).
3. Information on trade routes in Sabah.
4. More information on key consumers.
5. Effective human behaviour change campaign.
6. Human resources.
7. Funding.

Measures to be taken:

1. Set up the BSBCC's Sun Bear Conservation Unit.
2. Apply for funding.
3. Commence engagement program of BSBCC, WWF and other relevant stakeholders.
4. Establish workshops with TM practitioners.
5. Identify other private sectors that may need information.
6. BSBCC to establish a closer collaboration with TRAFFIC and WWF to work with FCPMDAM to handle the TM community.
7. Develop an outreach campaign (e.g., utilizing churches, religious leaders, celebrities)
8. Develop signboards at the state airports and elsewhere to raise awareness.
9. Make public announcements at airports, flights, etc.

Success measures:

1. Dedicated staff has been assigned.
2. Funding has been secured.
3. Closer collaboration between BSBCC, TRAFFIC, WWF has been established.
4. Closer engagement with the FCPMDAM has been established.
5. More regular workshops with industry are held.
6. Policy statement, mitigation measure and concessions related to sun bears have been increased.
7. Publicity has been increased.
8. More commitment and pledges made by the private sector have been made.

Lead agencies: BSBCC, SWD, WWF

Partners: TRAFFIC, plantation managers, other NGOs

Objective 5.2. Develop and support sun bear conservation research

Resources available:

1. Relevant BSG experts.
2. Cursory list of previous projects.
3. Dedicated staff assigned.
4. Publication on ex-situ research projects of priority (Schneider *et al.* 2020).
5. Data from other species projects.

Resources NOT available:

1. Review of past and current ex-situ and in-situ sun bear research projects in Sabah.

Measures to be taken:

1. Appoint a research officer within the BSBCC's Sun Bear Conservation Unit who will identify research gaps and priorities for Sabah.
2. Identify collaborative institutions such as universities and research centres to host potential MSc and PhD students from Malaysia and/or overseas.
3. Write-up research proposals of priority for sun bears in Sabah and propose which institutions are best suited to carry out the required research.

Success measures:

1. A report has been published with the research priority of ex-situ bears for sun bear conservation in Sabah.
2. A number of priority projects for sun bears in Sabah have been identified, described, and disseminated.

Lead agencies: BSBCC, SaBC

Partners: DGFC, BSG, SWD, SFD, Universities

SPECIES ACTION PLAN COMMITTEE



Top row from left to right: Matt Hunt, Dr Shyamala Ratnayeke, Dr Hamzah Bin Tangki, Heidi Quine, Dr Benoit Goossens, Dr Wong Siew Te, Dr Miriam Kunde, Peter Malim, Chin Suk Teng, Brian Crudge, Wai Pak Ng

Bottom row from left to right: Thye Lim Tee, Gloria Ganang, Audrey Adella Umbol, Mohd Soffian Abu Bakar, Dr Janmejay Sethy, Dr Macarena Gonzalez, Dr Yeow Boon Nie, Dr Cheryl Cheah, Chiew Lin May

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Sponsor:



Partners:

