

The Status & Distribution of Bears in Vietnam

2016



Free the Bears
Animals Asia

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Free the Bears is an international animal welfare and wildlife conservation charity headquartered in Perth, Australia, and supporting programmes in Cambodia, India, Indonesia, Laos, Thailand and Vietnam. Free the Bears works with governments and non-governmental partners to build, manage and sustain bear sanctuaries and field programmes aimed at ending the suffering of captive bears whilst protecting wild bears across Southeast Asia and India. As part of its mission to protect, preserve and enrich the lives of bears throughout the world Free the Bears has supported the rescue of over 900 bears and currently provides care for over 30 bears in Cat Tien Bear Rescue Centre, Cat Tien National Park, Vietnam, while also building a new sanctuary to increase capacity for further bears to be rescued from the bear bile industry.

Animals Asia is a registered charity with bear sanctuaries in China and Vietnam, headquarters in Hong Kong, and offices in Australia, China, Germany, Italy, the UK, USA, and Vietnam. Founded in 1998, Animals Asia promotes compassion and respect for all animals and works to bring about long-term change. Campaigns include working to end the barbaric bear bile trade, which sees over 10,000 bears kept on bile farms in China, and about 1,200 suffering the same fate in Vietnam. Animals Asia also works to end the trade in dogs and cats for food in China and Vietnam, and lobbies to improve the welfare of companion animals, promote humane population management and prevent the cross border export of "meat dogs" in Asia. In addition, Animals Asia campaigns for an end to abusive animal practices in zoos and safari parks in Asia, and works closely with governing authorities to improve animal management and increase awareness of the welfare needs of captive animals. Animals Asia has rescued over 160 bears in to their Vietnam Bear Rescue Centre in Tam Dao National Park, and has rescued over 400 bears in China.

Center for Environment and Rural Development (CERD) is a Vietnamese research centre based in Vinh University, Nghe An Province, Vietnam. CERD organize and implement research in the fields of environment, agriculture, forestry and fisheries, and rural development. CERD provide training and capacity building in the fields of the environment, natural resources and rural development, and collaborates on projects acting in the fields of biodiversity conservation, management and surveys.



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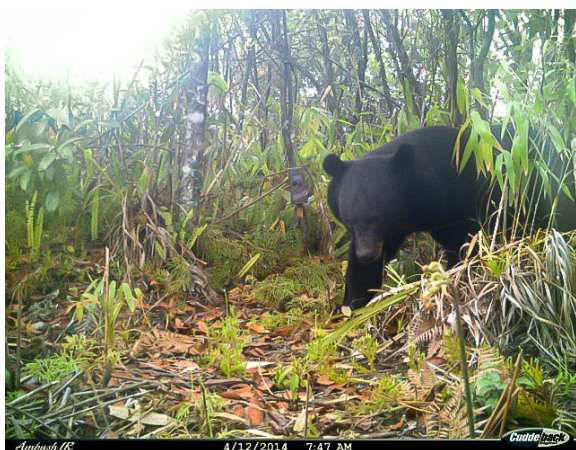
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Cover photo:

Camera trap image of a wild Asiatic black bear in northern Vietnam, in 2014. Photo credit: FFI/Nguyen Van Truong

Executive Summary

Vietnam is home to two native bear species: the Sun bear (*Helarctos malayanus*) and the Asiatic black bear (*Ursus thibetanus*). Both species have been poorly studied and little is known of their ecology, status or distribution in Vietnam. The objectives of this study were to: (1) ascertain the probable presence or absence of bears in selected sites across Vietnam; (2) gauge whether bear populations at these sites are likely increasing, decreasing, or stable; (3) determine whether population status differs between Sun bears and Asiatic black bears; (4) for declining populations, estimate the date when the decline started; and (5) attempt to understand the cause of population trends, and specifically whether they are likely linked to the expansion of bear farms.

Apart from two projects in Cat Tien National Park (Scotson et al., 2009; Crudge et al., 2016) there has been no known specific research of wild bears in Vietnam, and no reliable records of where bears exist. The current study is the first nationwide survey of bear distribution in Vietnam.

For this study, 22 Protected Areas were selected as focal survey sites, including 10 National Parks, 10 Nature Reserves, 1 Proposed Nature Reserve, and 1 Species and Habitat Conservation Area. The selected sites comprised 11,862 km² and represent approximately 50% of Vietnam's Special Use Forest.

Interviewing local villagers has been shown to be an efficient and reliable means of assessing distribution, and changes therein, for animals such as bears that often interact with people and leave obvious signs (Liu et al. 2009). Local ecological knowledge (LEK) is increasingly seen as an important source of information for conservation of rare and elusive species (Cano & Telleria, 2013; Turvey et al., 2015; Nash et al., 2016).

Individual interviews were conducted using a questionnaire designed to (i) assess the interviewee's ability to correctly identify and distinguish between the two native bear species, (ii) determine the current status and recent trends in the local bear populations, (iii) record information about the interviewee's most recent sightings of bears or bear sign, and (iv) document additional information about local threats, hunting and trade in bears and bear parts.

We interviewed 1,441 people in 106 villages adjacent to 22 Protected Areas. In each Protected Area, a majority of respondents reported seeing a bear in the forest at least once in their life. Although very few respondents considered bears to be numerous, the majority (77%) believed that bears were still present in their local forest area. This broad pattern is the case in 20 of the 22 Protected Areas, with 60-100% of respondents affirming the continued presence of bears. Respondents overwhelmingly (98%) thought bears had declined in the last 10 years. Dates of last sightings of bears indicate that encounter rates in the present are less than expected if bear populations were stable. The data are more consistent with declining bear populations. Interviewees who stated that bear populations had declined tended to think that the declines began between 1990 and 2005. Some interviewees believed bears to have been locally extirpated with extirpations thought to have occurred between 1995 and 2005.

Among the 98% of respondents who thought bear populations had declined, there was an overwhelming opinion that hunting (including trapping) was the primary cause.

The evidence presented here indicates that bear populations have declined throughout Vietnam with declines apparently starting within 5 years of the year 2000 in almost all Protected Areas. There is no site without clear evidence of a decline, or where the majority of most recent sightings occurred in the last 10 years.

There is no indication from the data that there are any strongholds for bear populations anywhere in Vietnam. There are no sites where sighting rates are markedly high, or where the data suggest anything other than a sustained population decline. On the positive side, however, there are only two out of 22 sites where the evidence clearly suggests extirpation. At most sites, occasional reported sightings continue into recent years or to the present.

The timing of the reported bear population declines appears similar across most sites in Vietnam, with respondents indicating that the declines began between 1990 and 2005, driven by hunting and trapping. This coincides with the time at which bear bile farming expanded rapidly in Vietnam.

The timing of bear population declines is evidence that bear farming in Vietnam and access to new technologies spurred increased hunting pressure on wild bears in a poaching free-for-all fuelled by heightened demand, access to markets, poor law enforcement, and the allure of financial profits.

While nowhere in Vietnam stands out as a stronghold for bear populations, bears still persist across the country. Camera trap images have confirmed the presence of Asiatic black bears in a number of sites and persistence of bears is also evidenced by ongoing hunting. However, the individual bears detected by camera trap or caught by poachers over the past few years may represent the last remnants of populations with little to no prospect of recovery without immediate investment in conservation.

Although no single site in Vietnam appears to offer great prospects for bear conservation, based on the evidence presented here, Quang Nam Province offers some hope in that it encompasses two Protected Areas that the data suggest are relatively good for bears: Quang Nam Saola Nature Reserve and Song Thanh Nature Reserve. The conservation potential of Quang Nam Province is enhanced by its central position within the Annamite Mountains, an area of global conservation importance due to its high species richness and endemism (Sterling and Hurley, 2005).

A nationwide survey of bear distribution was recommended as a priority action for the conservation of bears in Vietnam in 1999 (Servheen, et al., 1999), at a time when bear bile farming was in its infancy in Vietnam. In the years that followed, no such surveys were conducted, bear bile farming expanded rapidly and largely unimpeded by regulation, and, as this study shows, wild bear populations in Vietnam declined dramatically. If the recommended actions had been implemented in a timely manner, the authorities and the public may have been alerted to the unsustainable scale of poaching driven by bear bile farming, and had the evidence and time necessary to halt and potentially reverse the decline of bear populations in Vietnam.

The recommendations detailed below should be implemented immediately if we are to halt the decline of bear populations in the region and prevent bear numbers from declining further in Vietnam.

Recommendations

- This study indicates that the establishment of bear bile farming in Vietnam had no positive, and more likely extremely detrimental, impact on the conservation of wild bears. Vietnam should continue strengthening efforts to phase out bear bile farming completely.
- The Traditional Medicine community in Vietnam has committed to phasing out the use of bear bile products by 2020. Government and non-government partners should assist the Traditional Medicine community in promoting the use of herbal and synthetic alternatives to bear bile.
- Latest figures indicate that around 1,200 bears remain in bile farms and private households in Vietnam. For as long as bear bile farms exist in Vietnam it is possible that further pressure will be placed on wild bear populations. In order to hasten the phasing out of bear bile farming in Vietnam, the Ministry of Agriculture and Rural Development, in collaboration with partner NGOs, should conduct a thorough and rapid assessment of all remaining facilities, to determine the exact number of bears remaining, their ages, physical conditions and veterinary requirements. A management strategy should then be developed to rehome and provide life-long care for the bears in sanctioned rescue facilities as soon as possible. Rescue facilities should receive the governmental and financial support necessary to receive bears in a timely manner.
- Asiatic black bears and Sun bears are listed as CITES Appendix I species, thereby prohibiting international commercial trade in whole animals, parts, or derivatives. Concerted efforts should be made while phasing out bear bile farming in Vietnam to ensure that it does not result in bears being trafficked illegally to neighbouring countries to facilitate the growth of or supplement the bear bile farming industry beyond Vietnam's borders.
- The detrimental impacts of commercial wildlife farming, as clearly demonstrated by the case of bear bile farming in Vietnam and the almost complete loss of wild bears, should serve as a warning to those considering commercial farming of bears and other species for conservation purposes in Vietnam and beyond. Any state considering commercial wildlife farming as a conservation strategy should conduct a thorough assessment of wild populations and determine what level of off-take, if any, would be sustainable on a species-by-species basis before engaging in such a potentially disastrous strategy. Stringent monitoring is required and if evidence suggests that sustainable levels of off-take have been surpassed then a moratorium should be enacted immediately to prevent further harvesting from wild populations.
- Quang Nam and adjacent Kon Tum Provinces encompass four study sites that have been identified as offering comparatively good potential for wild bear conservation. Investment should be made in protection and research activities at these sites. NGOs should engage at the provincial level in order to conserve the priority sites of Song Thanh Nature Reserve (Quang Nam Province), Quang Nam Saola Nature Reserve (Quang Nam Province), and Chu Mom Ray National Park (Kon Tum Province). Conservation of bears in Ngoc Linh Nature Reserve, which has sectors in both provinces, would benefit from a unified strategy and investment in bear conservation, including further research, law enforcement patrols, and community outreach.

- An assessment of bear population status and threats in Dong Amphan National Park, Attapeu Province in southern Laos, should be conducted immediately in order to assess its connectivity to, and potential to provide source populations and habitat connectivity to, the priority sites of Chu Mom Ray National Park and Ngoc Linh Nature Reserve in Kon Tum Province, as well as the adjacent Song Thanh Nature in Quang Nam Province.
- Hunting and trade in bears and their parts is ongoing in violation of national laws and international conventions. Individuals caught illegally collecting, selling, buying, transporting or keeping bears or their parts or derivatives, should be prosecuted to the full extent of the law. Prosecutions should be publicised on national media and penalties should be severe enough to serve as a deterrent to individuals in the future.
- Ongoing trade in bears and their parts is a severe threat to Vietnam's few remaining wild bears. Relevant government agencies should support and collaborate with local and international organizations to conduct campaigns throughout Vietnam to end the illegal consumption of bear bile products. The results of this project should be used for demand reduction campaigns in the urban centres of Vietnam, and used in site-based conservation projects to educate local people about the conservation importance of their respective sites and develop a sense of pride in species conservation.
- Bear sign and camera trap surveys should be conducted at selected sites sampled in this study in order to confirm the continued presence of bears at the sites and identify a long-term monitoring plan.

Introduction

Vietnam is home to two native bear species: the Sun bear (*Helarctos malayanus*) and the Asiatic black bear (*Ursus thibetanus*), also known as the Moon bear. The Sun bear and Asiatic black bear are both listed as Vulnerable on the IUCN Red list of Threatened Species and as Endangered on the Red Data Book of Vietnam (IUCN, 2016a; IUCN, 2016b). The species are offered protection nationally and internationally. Both species have been poorly studied and little is known of their ecology, status or distribution in Vietnam. The objectives of this study were to: (1) ascertain the probable presence or absence of bears in selected sites across Vietnam; (2) gauge whether bear populations at these sites are likely increasing, decreasing, or stable; (3) determine whether population status differs between Sun bears and Asiatic black bears; (4) for declining populations, estimate the date when the decline started; and (5) attempt to understand the cause of population trends, and specifically whether they are likely linked to the expansion of bear farms.

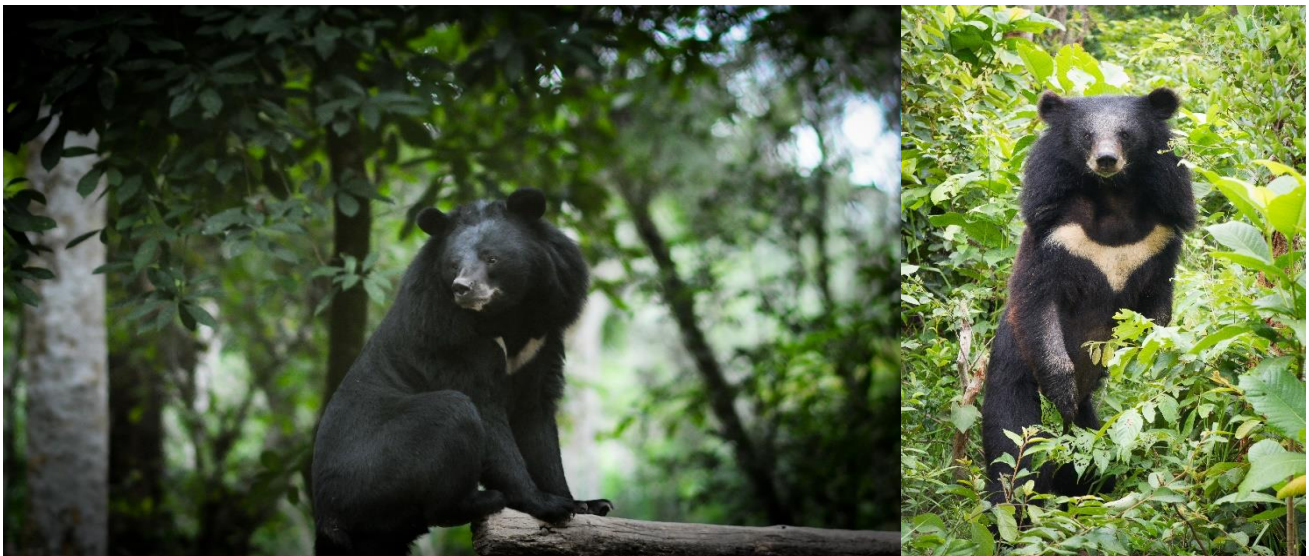


Figure 1. Asiatic black bear, *Ursus thibetanus*

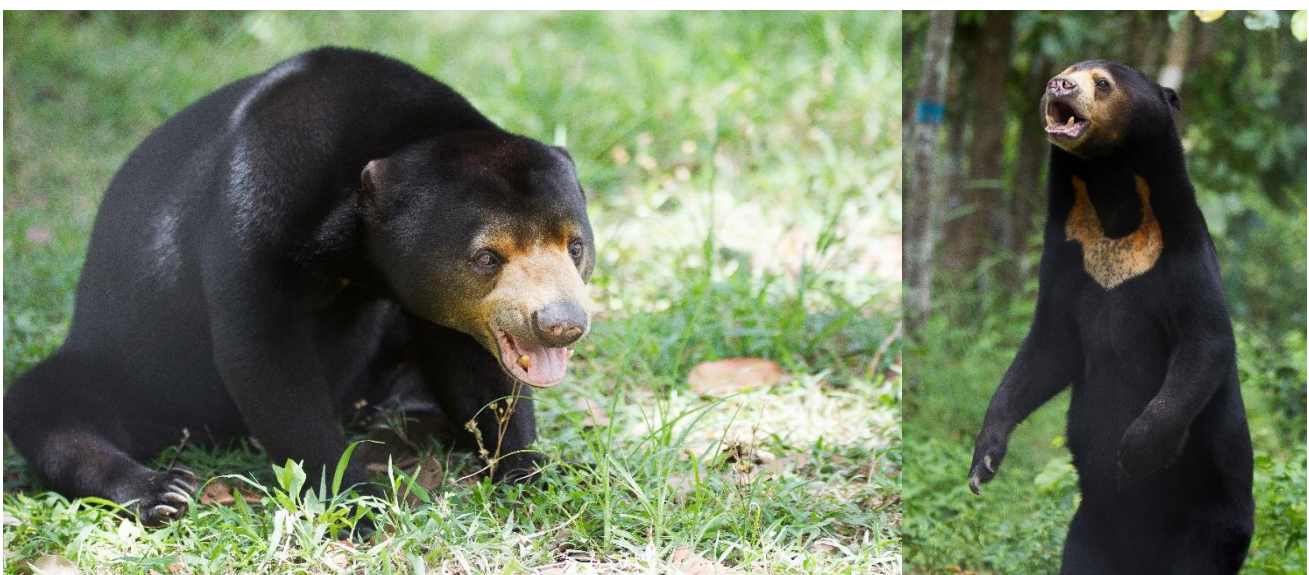


Figure 2. Sun bear, *Helarctos malayanus*

Distribution & Population Trends

Asiatic black bears occur in all countries in mainland Southeast Asia except Malaysia and Singapore. The species occupies a narrow band from southeastern Iran eastward through Afghanistan and Pakistan, across the foothills of the Himalayas, to Myanmar. It has a patchy distribution in southern China, and is absent in much of east-central China. Population clusters exist in northeastern China, the Russian Far East, and into North Korea. They occur on the islands of Taiwan and Hainan, the southern islands of Japan, and a small remnant population exists in South Korea. The species occurs very patchily through much of its former range, especially in Iran, Afghanistan, Pakistan, mainland Southeast Asia and China. Its distribution in parts of China and Myanmar remains very poorly known.

The distribution of the Asiatic black bear roughly coincides with forest distribution in southern and eastern Asia, except that in central and southern India this species is replaced by the Sloth bear (*Melursus ursinus*), in the north and west of the Russian Far East it is replaced by the Brown bear (*Ursus arctos*), and in southern Thailand and into Malaysia it is replaced by the Sun bear (*Helarctos malayanus*). However, the Asiatic black bear overlaps the ranges of each of these species, especially the Sun bear in a large portion of Southeast Asia.

Sun bears occurred historically in mainland Southeast Asia as far west as Bangladesh and northeastern India, as far north as southern Yunnan Province in China, and south to Sumatra and east to Borneo. Now the species occurs in isolated forest blocks through much of its former range, and has been extirpated from many areas, especially in mainland Southeast Asia. Their existence in China and Bangladesh is now doubtful (IUCN, 2016b, Islam et al., 2013).

In mainland Southeast Asia Sun bears appear to exhibit a natural population gradient from south to north, being more abundant in southern regions and becoming less common towards the northern edge of their range (Steinmetz, 2011). The northeastern edge of the Sun bears range ends at the Red River in Vietnam, limited presumably by colder climates and unfavorable habitats (IUCN, 2016a).

Asiatic black bears and Sun bears are threatened throughout their ranges by habitat loss and illegal hunting for their gallbladders and other body parts to supply the demand for Traditional Medicine and exotic meat. Live bear cubs are often captured for use as prestigious pets or to stock bear bile extraction facilities, commonly referred to as bear bile farms or simply bear farms (IUCN, 2016a; IUCN, 2016b).

Widespread illegal killing of bears and trade in parts, combined with loss of habitat indicate that the Asiatic black bear is likely declining throughout most its range. Japan appears to be the only range country (of 18) that has documented naturally increasing numbers of Asiatic black bears, reflected by an increasing area of occupied range (Oi and Yamazaki 2006). South Korea has been partially successful in restoring their wild bear population through restocking, initially with captive-born bears, and later with orphaned wild bears from Russia. It is believed that there were about 40 bears in the South Korea population in 2015 (IUCN, 2016b).

Although data on Asiatic black bear population sizes or trends are available for only a few sites, it seems likely, given the rate of habitat loss and uncontrolled exploitation, that the world population has declined by more than 30% over the past 30 years and that this rate will continue during the next 30 years unless abated by the implementation of significant conservation measures (IUCN, 2016b).

Similarly, quantitative data on Sun bear population sizes or trends are available for just a few sites, but it is suspected that the global population has declined by >30% over the past 30 years. Deforestation has reduced both the area of occupancy and extent of occurrence of Sun bears, and has also reduced habitat quality in remaining forest. Given the Sun bear's dependence on forest, it is clear that the large-scale deforestation that has occurred throughout Southeast Asia over the past three decades has dramatically reduced suitable habitat for this species (IUCN, 2016a). In addition, Sun bear numbers have been reduced by uncontrolled exploitation for body parts in many parts of mainland Southeast Asia. It is expected that commercial exploitation will continue during the next 30 years unless abated by the implementation of significant anti-poaching, law enforcement and demand reduction measures.

Hunting bears in Vietnam has been historically prolific due to commercial demand fuelled by use of bear parts in Traditional Medicine (TM). Over-harvesting combined with loss of habitat has resulted in the drastic decline of populations which have become increasingly fragmented and under threat of extirpation (Free the Bears, 2009; Nguyen, 2006).

Bear Bile Farming

Wildlife farming has been used for a number of species to enhance production of sought-after products while ostensibly replacing and hence diminishing the offtake of wild individuals. Bile is a liquid produced in the liver and stored in the gallbladder of many vertebrate species. Bear bile has been used in Traditional Medicine for over a thousand years in the treatment of sore throats, sores, haemorrhoids, sprains, bruising, muscle ailments, epilepsy and liver disease. It is typically traded in the form of whole or pieces of dried gallbladder, raw liquid bile, dried bile powder, pills, flakes, and ointment (Foley et al., 2011). The only known therapeutic component of bile is ursodeoxycholic acid (UDCA) which, although found in the bile of other mammals, is most concentrated in the bile of bears, especially Polar bears (*Ursus maritimus*), Brown bears (*Ursus arctos*) and American Black bears (*Ursus americanus*) (Hagey et al., 1993; *U. thibetanus* not tested). Pharmaceutical grade UDCA is produced from the bile of slaughtered livestock and was introduced to modern medicine in the early 1900's (Foley et al., 2011). Despite the availability of synthetic UDCA and over 50 effective herbal alternatives, bear bile and bile products remain in high demand (Burgess et al., 2014).

Traditionally bear bile products were only obtainable by killing wild bears. In the 1970's a method was developed in North Korea to extract bile from living bears: so called bear bile farming. By the mid-1980's bear bile farming in China was sanctioned by the government as a means of reducing demand for wild bile and hence conserving wild bear populations (Foley et al., 2011).



Figure 3. Female Asiatic black bear (left) held on a bear bile farm in Vietnam in 2016. The injury to her front left paw is indicative of, and reported to be, a snare injury from when she was caught in the wild.

In Vietnam the number of bears kept for bile extraction increased rapidly over a ten year period - from approximately 500 bears in 1997 to 4,349 in 2006, due to stocking with bears taken from the wild. Although the term 'bear bile farm' suggests that bears are bred at these facilities, in reality very little breeding occurs and bear bile farms continue to rely on wild-sourced bears (Foley et al., 2011; Livingstone and Shepherd, 2014). Asiatic black bears make up the vast majority of bears kept in bile extraction facilities, with relatively few Sun bears. Regulations were introduced in 2005 intended to limit the number of wild-sourced bears from entering captive facilities (see below). At the time, all bears on farms were of illegal origin. The introduction of regulations did not legalise bear bile farming, the bears remained property of the government and, although individuals were permitted to keep registered bears, it was illegal to extract bile from these bears. However, even after 2005 the illegal trade continued with many animals trafficked illegally from neighbouring countries (Nguyen, 2007; Robinson et al., 2007; Loeffler et al., 2009; MacGregor, 2010; Vu, 2010; Burgess et al., 2014; Livingstone and Shepherd, 2016).

It is understood that for the purposes of Traditional Medicine, wild-sourced products are believed to be more potent than products produced from captive animals and are therefore preferred (Drury 2009; Dutton et al., 2011). The availability of farmed bear bile may actually increase the amount people are willing to pay for wild bear bile (i.e. bile from bears that were living and killed in the wild, as opposed to caught in the wild and kept on bile farms), thereby increasing the incentive to hunt wild bears (Dutton et al., 2011). Furthermore, the availability of a cheaper product that is perceived by consumers to be inferior may create a consumer base that is willing to upgrade. In Vietnam the widespread accessibility of farmed bear bile has resulted in a large consumer base that considers bear bile to be an effective and necessary household medicine (Drury, 2009).

Recent reports from the Ministry of Agriculture and Rural Development in Vietnam indicate that the number of bears being held on farms is in decline, from a peak of almost 5,000 in 2005, down to approximately 2,000 in 2014, and 1,245 in 2015 (Animals Asia, 2015). The exact reason for this is not clear but may be linked to a number of factors such as improved law enforcement, increased awareness, changing attitudes, consumer preference, natural mortality, or any number of factors. While demand for bear bile appears to be waning in Vietnam (ENV, 2015), wild bears continue to be killed or captured by poachers, and the price of their bile and other parts remains high (Burgess et al., 2014; Livingstone and Shepherd, 2014).

The rapid growth in the number of bears on farms in Vietnam between the mid-1990's and 2005 (Nguyen, 2007), and continuing illegal trade (Burgess et al., 2014), has had unknown impacts on wild bear populations throughout the region and has placed added demands on the limited resources of the Forest Protection Department who are tasked with monitoring the bears in captivity and protecting bears in the wild.

Conservation and Management

Several national and international organisations work in Vietnam to raise public awareness, reduce demand for bear bile, improve law enforcement capacity, and provide sanctuary for rescued and confiscated bears. Regular meetings of the Vietnam Bear Working Group are attended by Animals Asia, Free the Bears, Education for Nature – Vietnam (ENV), Four Paws, World Animal Protection, WWF, and TRAFFIC. Free the Bears currently provides life-long care to over 30 rescued bears housed at Cat Tien Bear Rescue Centre in southern Vietnam, and Animals Asia cares for over 150 bears at the Vietnam Bear Rescue Centre in the north. Additional rescued bears are housed in: the Hanoi Wildlife Rescue Centre in Soc Son District, Hanoi; Hon Me Wildlife Rescue Station in Kien Giang Province; and Cu Chi Wildlife Rescue Station in Cu Chi District of Ho Chi Minh City.

Education for Nature – Vietnam has sustained a long-term awareness raising campaign to reduce demand for bear bile products in Vietnam, and its Wildlife Crime Unit undertakes regular monitoring and surveys of bear farms, and tracks cases involving bears or bear products.

In recognition of the threat posed by hunting and trade, Asiatic black bears and Sun bears have been listed on Appendix I of CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) since 1979 (CITES, 2016a), thereby prohibiting international commercial trade in whole live or dead specimens, their parts or derivatives between member states. Vietnam has been a party to CITES since 1994. Neighbouring China, Cambodia and Laos joined CITES in 1981, 1997, and 2004, respectively (CITES, 2016b).

In 1997, noting that poaching may be causing declines of wild bears that could lead to the extirpation of certain populations or even range countries, the 10th Conference of the Parties to the Convention issued a Resolution on Conservation of and trade in bears. The Resolution urges member states to improve legislation, increase law enforcement, and identify, target and eliminate illegal markets (Resolution Conf. 10.8 (Rev. CoP14)).

According to the CITES National Legislation Project, Vietnam is believed to have national legislation that generally meets the requirements for implementation of CITES (CITES, 2015c). The primary regulations pertaining to the conservation and management of bears in Vietnam include, but are not limited to, the following:

- Decision No. 02/2005/QĐ-BNN dated 5 January 2005, Decision No. 47/2006/QĐ-BNN dated 6 June 2006, and Decision No. 95 QĐ/2008/BNN-KL dated 29 September 2008. These decisions constitute the Regulation on Captive Bear Management. These decisions are intended not to acknowledge the legality of the farmers, who have bears without legal origins, but to manage the current number of captive bears, stopping the hunting of bears from the wild for captive farming (ENV, 2016).
- Decree 32/2006/ND-CP dated 30 March 2006 on Management of Endangered, Precious, and Rare Species of Wild Plants and Animals. This decree stipulates management and the list of endangered, precious, and rare wild plants and animals of Vietnam's forests. Asiatic black bears and Sun bears are listed in Group 1B, prohibiting their exploitation and use for commercial purposes including hunting, keeping, transporting, processing, advertising, buying, selling, importing and exporting (ENV, 2016).
- Decree 82/2006/ND-CP dated 10 August 2006 on the management of export, import, re-export, introduction from the sea, transit, breeding, rearing and artificial propagation of endangered species of precious and rare wild fauna and flora (ENV, 2016).
- Decree 160/2013/ND-CP dated 12 November 2013 on criteria to determine species and regime of managing species under the list of endangered, precious and rare species prioritized for protection. The Decree regulates a system of criteria to evaluate and identify which species shall be prioritized for protection (ENV, 2016).
- A revised penal code was expected to come into force in July 2016. The revision stipulates stricter criminal punishments for wildlife offenses and was expected to strengthen wildlife law enforcement. However, enactment of the new penal code was postponed to allow further revision (ENV, 2016).



Figure 4. Bear bile illegally advertised for sale in Vietnam, online (left) and in a restaurant (right).

In September 2012, at the IUCN World Conservation Congress in Jeju, South Korea, IUCN members, which include government and non-government organizations, voted to pass a motion to examine the effects of bear farming on wild populations of bears, and to phase-out farming where it is clearly having negative impacts on wild bears (IUCN, 2012). Observing that ample evidence exists that increased supply of farmed bear bile has not alleviated the exploitation of wild bear populations, and aware that stocking of farms with bears taken from the wild is not uncommon, and can be directly linked to illegal hunting and cross-border trade of wild bears, the resolution urges South Korea and Vietnam to “continue their efforts towards ending bear farming” and for all bile farming countries to improve monitoring of wild bear populations and promote the development and use of bear bile substitutes (IUCN, 2012).

Conservation action plans for Asiatic black bears and Sun bears published in 1999 recommended, among other actions, surveys throughout Vietnam for distribution and population of bears (Servheen et al., 1999). A 2006 review of the status and conservation of bears in Vietnam noted that by the 1990's the geographic distribution of Asiatic black bears and Sun bears in Vietnam had decreased and populations had become fragmented and primarily restricted to National Parks and Nature Reserves. Development of bear conservation-related studies such as an assessment of wild bear status, distribution and population size was highlighted as a priority action for the conservation of bears in Vietnam (Japan Bear Network, 2006).

Apart from two projects in Cat Tien National Park (Scotson et al., 2009; Crudge et al., 2016) there has been no known specific research of wild bears in Vietnam, and no reliable records of where bears exist. The current study is the first nationwide survey of bear distribution in Vietnam – sixteen years after being recommended as a priority conservation action. Part of the reason for the delay has been the difficulty in mobilizing sufficient funds for a comprehensive field surveys on such a scale. Both the physical and institutional landscapes provide complex obstacles to field surveys in Vietnamese forests. Even if they could be carried out across the country, field surveys would be unable to detect trends in bear populations unless two surveys could be conducted several years apart. If bears are already very rare, which local reports suggest may be the case, then unrealistically high survey effort would be needed in order to detect a trend (Taylor & Gerrodette 1993). For these reasons, we have chosen to conduct a survey based on interviews with local people. Use of interview data is problematic because local people's reports are subject to numerous sources of error and bias (Keane 2013). However this is the best available approach to getting an overall view of the status of bears across such a wide area. Further field surveys could be used to confirm the results at a select number of sites of conservation interest.

Methods

Study Area

Vietnam is situated on the eastern margin of the Indochinese Peninsula, bordered to the north by China, to the west by Laos and Cambodia, to the southwest by the Gulf of Thailand, and to the east by the South China Sea (known locally as the East Sea). Elevations range from sea level to 3,144 m a.s.l. at the summit of Mount Fansipan, the highest peak in Indochina. Vietnam has a tropical monsoon climate but with a north-south orientation of approximately 1,650 km, covering 14 degrees of latitude, there is considerable regional variation (Sterling & Hurley, 2005; Chaudhry & Ruyschaert, 2007).

Vietnam has a landmass of approximately 329,500 km², three-quarters of which is hilly and mountainous. Forest coverage is increasing due mainly to large-scale reforestation and afforestation projects, consisting largely of monoculture plantations of exotic species, particularly acacia and eucalyptus, which have lower biodiversity and ecosystem values than natural forest (MARD, 2014; WWF 2013a). Conversely, natural forest cover fell by 43% from 1973 to 2009, and natural forest patches became more isolated and separated by swaths of altered landscapes, restricting movement of species and increasing access to hunters (WWF, 2013a).

Approximately 7% (~22,000 km²) of Vietnam's land mass falls within 164 designated Special Use Forests. These include 30 National Parks, 58 Nature Reserves, 11 Wildlife Reserves, 45 protected landscapes, and 20 experimental forests for scientific research (MARD, 2014).

For this study, 22 Protected Areas were selected as focal sites based on historical distribution of bears, previous records of bear presence, habitat type, distance from large urban populations, distance from neighbouring forest patches, and distribution of sites throughout Vietnam. The sites included 10 National Parks, 10 Nature Reserves, 1 Proposed Nature Reserve, and 1 Species and Habitat Conservation Area (Table 1; Figure 5). The selected sites comprised 11,862 km². Excluding Chu Prong Proposed Nature Reserve (480km²), this represents 52% of Vietnam's Special Use Forest.

Protected Area boundaries do not necessarily coincide with the forest areas used by members of a community or wild populations. Sample villages were selected based on known or predicted use of forest areas that fell, at least in part, within Protected Area boundaries.

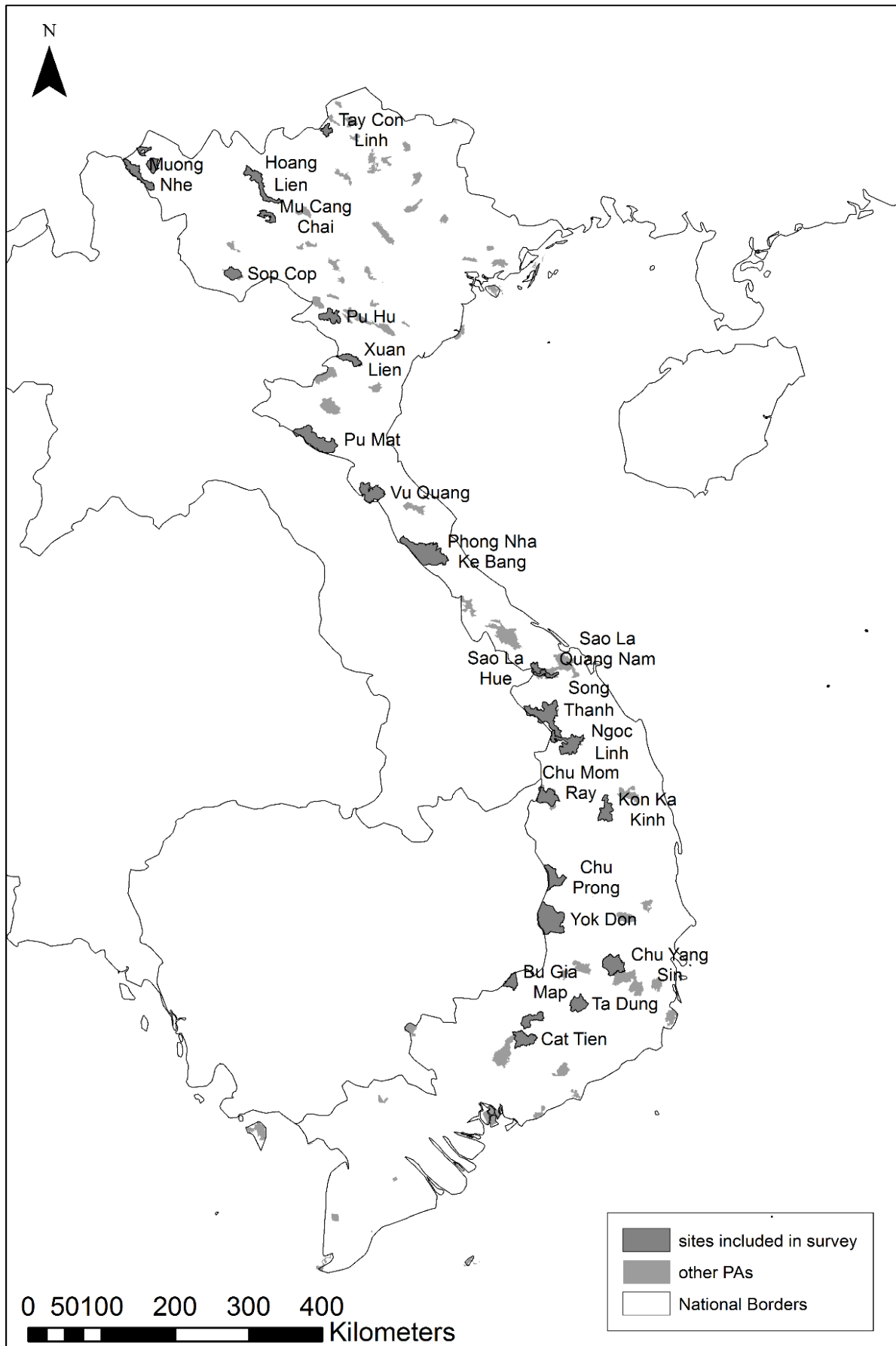


Figure 5. Map of Vietnam showing the 22 Protected Areas that were surveyed.

Interview surveys

We used a structured interview questionnaire designed with input from researchers with experience conducting ecological surveys in the region, including members of the IUCN/SSC Bear Specialist Group. Surveys were conducted from April 2015 to January 2016. Prior to the surveys a team of 13 researchers from Vinh University, Nghe An Province, Vietnam, participated in a week-long classroom- and field-based training workshop, and each received a Vietnamese copy of the survey protocol and interview guidance documents. The workshop and guidance documents were designed to provide comprehensive training and instruction in interview methods and in how to distinguish between the two native bear species based on descriptions of physical features. The training workshop was used to field test the questionnaire instrument and feedback was incorporated into the final questionnaire form. Surveys were conducted by three teams of 3-4 trained Vietnamese researchers.

Interviewing local villagers has been shown to be an efficient and reliable means of assessing distribution, and changes therein, for animals such as bears that often interact with people and leave obvious signs (Liu et al., 2009). Local ecological knowledge (LEK) is increasingly seen as an important source of information for conservation of rare and elusive species (Cano & Telleria, 2013; Turvey et al., 2015; Nash et al., 2016). Millions of rural people in Vietnam live in close proximity to forest. Many villages, including those selected as survey sites, rely, at least in part, on local forest for hunting and harvesting non-timber forest products (Robertson et al., 2003; Nga, 2006; Quang & Anh, 2006; McElwee, 2008).

At each survey site, in order to determine sample area (i.e. the area of forest used by a community and from which their knowledge of a bears is derived), we conducted village-level community mapping. Community mapping is making maps using information provided by local people and can be used for a number of purposes, including land use planning, natural resource management, and ecological research.

Following the survey protocol, upon arrival in the village the survey team met first with the village headman and explained the purpose of the research. A village meeting was then organised, typically attended by a cross-section of the community, including men and women, old and young adults. The research team introduced themselves and explained that they were conducting a research project and that they were interested in wildlife, with an emphasis on bears. The focus of the research was made clear from the outset because we were aware that the focus of the interviews would become apparent and would likely be broadcast throughout the village, which, if it wasn't clear from the beginning, could be a source of additional bias in later responses.

During village meetings villagers were presented with a base map (84.1 x 118.9 cm) of their area. Base maps contained rivers and streams, some roads, and a 1 km UTM WGS84 grid, as used on modern 1:50,000 national topographic maps. Maps included locations of some larger nearby towns or cities, but not the locations of smaller villages which may be inaccurate. Also excluded from the base map were administrative boundaries, such as commune boundaries and Protected Area boundaries, since local people do not necessarily know where these are. The location of the sample village was confirmed on-site using a GPS unit and then marked on the base map.

The base map was placed in the centre of the group and a compass was used to situate the map in the right direction. Rivers and streams were considered to be the most useful geographical feature for community mapping. Villagers were asked to discuss the map and to identify and write down the names of rivers, streams and features of the forest in the area that the community uses. Other features that were recorded included the names of hills or mountains, the location of nearby villages or the previous locations of the sample village if it had moved in the past. Revisions could be made and additional streams added if they were not shown on the map.

Once consensus had been reached that the map was complete and correct, villagers were asked, as a group, to use corn kernels or beans to mark the boundary of the area which the community uses. Types of use could include fishing, hunting, and collecting non-timber forest products. Once the area was marked, the map was labelled and photographed. This image was later imported to GIS and used to create a geo-referenced polygon of village use area. For each study site the village use polygons were combined and the overlap omitted to represent the total sample area at the site.

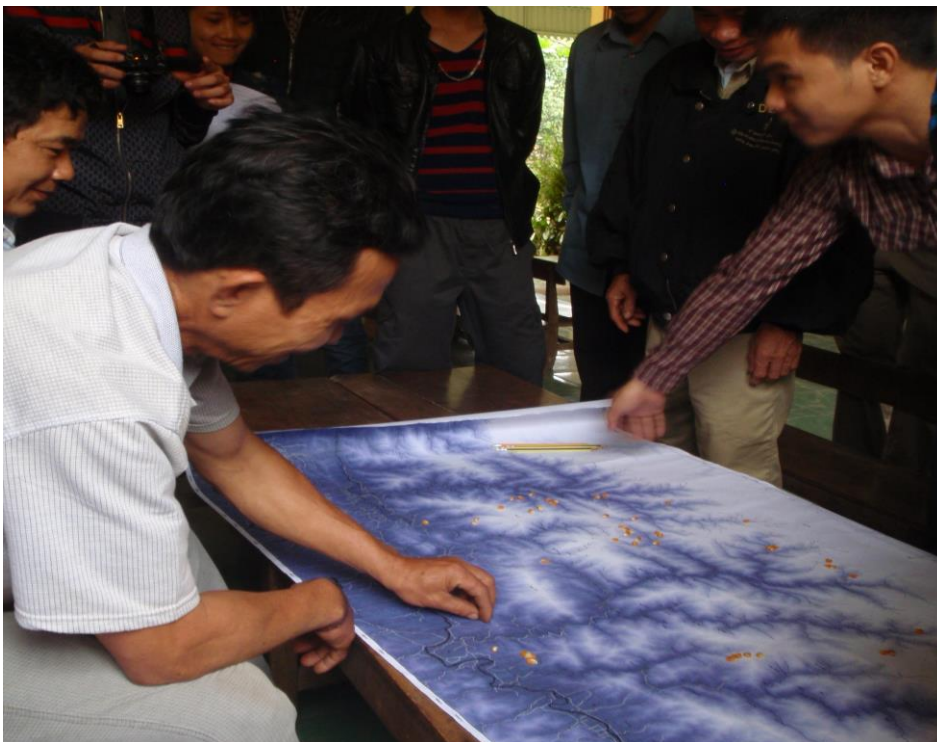


Figure 6. Community members use corn kernels to mark the boundary of the village forest use area.

One-on-one interviews were arranged during the village meeting and through snowball sampling, whereby the village headman or past interviewees recommend other people in the village to interview who had knowledge of the forest or past experience of bears. In the survey sites, hunting and associated knowledge about wildlife is considered to be the domain of men and we predominately interviewed men. However, women also access the forest and have the opportunity to encounter bears and so were also included in this survey. Individual interviews were conducted using a questionnaire designed to (i) assess the interviewee's ability to correctly identify and distinguish between the two native bear species, (ii) determine the current status and recent trends in the local bear populations, (iii) record information about the interviewee's most recent sightings of bears or bear sign, and (iv) document additional information about local threats, hunting and trade in bears and bear parts.

Data analysis

We tallied the responses of interviewees to questions about the current status of bears and trend in bear populations, as well as perceived causes of trend. The most complex analysis involved the data on last sightings of bears. We plotted histograms of these data in each of the 22 Protected Areas. If the sighting rate of bears has not declined, these histograms should show a decreasing number of reported sightings moving back through time, since we only recorded the most recent sighting by each interviewee (i.e., one date per interviewee). Therefore each sighting in a recent year will prevent the recording of any sightings by the same interviewee in earlier years. Conversely, if a species is declining the downwards curve towards the past will be less steep. In extreme cases, this will produce a humped distribution with the mode in an earlier year than the survey year. This is more likely to occur when detection rate is low (Turvey et al. 2012).

If the sighting rate is constant, the dates of the last sightings should follow the geometric distribution (equivalent of the exponential distribution for discrete data). The geometric distribution has one parameter (p_j) which, in this case, indicates the average annual encounter probability with bears for an interviewee in Protected Area j . A maximum likelihood estimate can be obtained from the data assuming they follow a geometric distribution according to the following equation:

$$\hat{p}_j^g = \frac{n}{\sum_{i=1}^n (k_i + 1)}$$

where n is the total number of sightings and k is the number of years ago with the survey year counted as year zero. If species encounter rates have actually declined over time this maximum likelihood estimate will be an underestimate of the real annual encounter rate.

We calculated the maximum likelihood estimate of encounter rate at each Protected Area and used this estimate to produce an expected distribution for each area under the assumption that sighting rates did not change. We plotted the expected values from these distributions as lines on the individual histograms.

We conducted goodness of fit tests to test the null hypothesis that the real histograms did not differ from these expected distributions. We used two non-parametric, one-sample goodness-of-fit tests, a one-tailed Kolmogorov-Smirnov (KS) test and the Cramér-von Mises (CvM) test for discrete distributions (Choulakian et al. 1994). Both tests compare the cumulative density function (cdf) of the null distribution with the empirical cdf derived from the data. The alternative hypothesis of the CvM test is that the cdf of the data differs from that of the H_0 distribution. The alternative hypothesis of the one-tailed KS test is that the cdf of the data is lower than that of the H_0 distribution, a pattern consistent with species decline. While the KS-test allows a more specific alternative hypothesis, the CvM test is generally more powerful (Arnold & Emerson 2011). Both tests were implemented using the R package *dgof* (Arnold & Emerson 2011) which provides the appropriate formulation for discrete distributions. Holm-Bonferroni correction was applied across all 22 Protected Areas to the resultant p-values for each test ($n=22$).

Results

We interviewed 1,441 people in 106 villages adjacent to 22 Protected Areas, averaging 65.5 (SD±10.99) interviews per Protected Area. In each Protected Area, a majority of respondents reported seeing a bear in the forest at least once in their life (Table 1).

*Table 1. Number of interviews from each Protected Area, and the percent of interviewees reporting having seen a bear.**

	Protected Area	No. villages	Total no. interviews	Interviews with bear sightings	Interviews with dated sightings
1	Bu Gia Map National Park	4	60	51 [85%]	49 [82%]
2	Cat Tien National Park	5	70	43 [61%]	41 [59%]
3	Chu Mom Ray National Park	5	67	45 [67%]	27 [40%]
4	Chu Prong Proposed Nature Reserve	4	60	51 [85%]	42 [70%]
5	Chu Yang Sin National Park	4	67	50 [75%]	34 [51%]
6	Hoang Lien National Park	4	31	23 [74%]	20 [65%]
7	Hue Saola Nature Reserve	5	69	66 [96%]	53 [77%]
8	Kon Ka Kinh National Park	5	66	38 [58%]	30 [45%]
9	Mu Cang Chai Species and Habitat Conservation Area	6	57	41 [72%]	27 [47%]
10	Muong Nhe Nature Reserve	4	69	61 [88%]	60 [87%]
11	Ngoc Linh Nature Reserve	4	53	35 [66%]	26 [49%]
12	Phong Nha-Ke Bang National Park	6	71	58 [82%]	48 [68%]
13	Pu Hu Nature Reserve	4	73	55 [75%]	50 [68%]
14	Pu Mat National Park	5	83	75 [90%]	69 [83%]
15	Quang Nam Saola Nature Reserve	5	79	70 [89%]	25 [32%]
16	Song Thanh Nature Reserve	7	81	46 [57%]	16 [20%]
17	Sop Cop Nature Reserve	5	54	51 [94%]	50 [93%]
18	Ta Dung Nature Reserve	4	59	32 [54%]	16 [27%]
19	Tay Con Linh Nature Reserve	5	60	54 [90%]	54 [90%]
20	Vu Quang National Park	5	75	63 [84%]	55 [73%]
21	Xuan Lien Nature Reserve	5	67	67 [100%]	60 [90%]
22	Yok Don National Park	5	70	62 [89%]	43 [61%]

* total no. interviews gives numbers of interview datasheets collected from around each PA. The next two columns give the numbers and percentages of those interviews for which at least one bear sighting was reported and for which at least one sighting was reported with information on date.

Responses from interviewees covered a sampling area of 10,700 km², representing the area traditionally used by members of villages that were surveyed. Interviewees were asked specifically about bears from within this area and it is assumed that information provided about bears, including sightings, refers to this area known to the villagers. Of this effective survey area, 6,120 km² was inside Protected Area boundaries and the rest was in nearby forest areas contiguous with the Protected Areas (Table 2; Figures 7 - 9). On average, the proportion of Protected Areas covered was 58% (SD±22.6). Incomplete coverage is a concern particularly in Muong Nhe Nature Reserve, Phong Nha-Ke Bang National Park, Kon Ka Kinh National Park and Ta Dung Nature Reserve. Hoang Lien National Park is divided into two sections of which our survey covered only the northern section, and similarly only Nam Cat Tien and Tay Cat Tien sectors of Cat Tien National Park were covered by our survey. The possibility therefore exists that areas exist within these Protected Areas where the status of bear populations differ from that suggested by our results.

Table 2. Proportion of Protected Areas sampled, based on village use areas identified through community mapping.

Protected Area (PA)	Total Area of PA (Km ²)	Area covered inside PA boundary (Km ²)	PA coverage (%)
Bu Gia Map National Park	252.6	233.8	92.6
Cat Tien National Park	789.3	221.2	28.0
Chu Mom Ray National Park	487.5	478.9	98.2
Chu Prong Proposed Nature Reserve	480.0	270.9	56.4
Chu Yang Sin National Park	584.4	475.7	81.4
Hoang Lien National Park	539.4	189.5	35.1
Hue Saola Nature Reserve	154.1	129.7	84.2
Kon Ka Kinh National Park	418.1	193.0	46.2
Mu Cang Chai Species and Habitat Conservation Area	201.3	182.8	90.8
Muong Nhe Nature Reserve	805.6	207.6	25.8
Ngoc Linh Nature Reserve	676.4	252.7	37.4
Phong Nha-Ke Bang National Park	1,258.2	372.2	29.6
Pu Hu Nature Reserve	350.0	213.8	61.1
Pu Mat National Park	967.3	685.0	70.8
Quang Nam Saola Nature Reserve	160.6	128.6	80.1
Song Thanh Nature Reserve	950.0	535.8	56.4
Sop Cop Nature Reserve	278.3	187.4	67.3
Ta Dung Nature Reserve	371.5	92.0	24.8
Tay Con Linh Nature Reserve	150.0	94.0	62.7
Vu Quang National Park	574.7	249.5	43.4
Xuan Lien Nature Reserve	267.6	116.0	43.3
Yok Don National Park	1,145.2	611.1	53.4

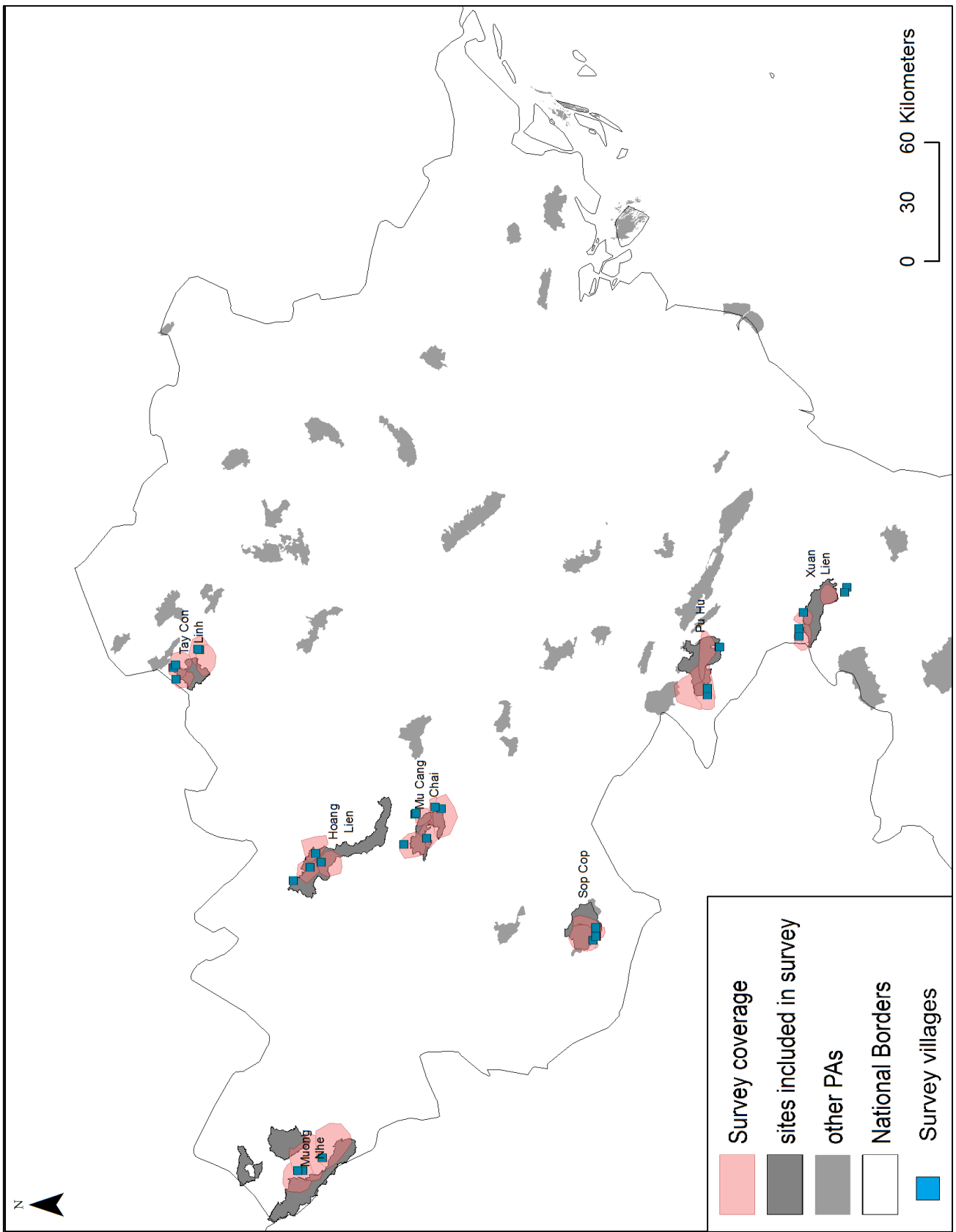


Figure 7. Map showing surveyed Protected Areas, surveyed village locations, and survey coverage in Northern Vietnam.

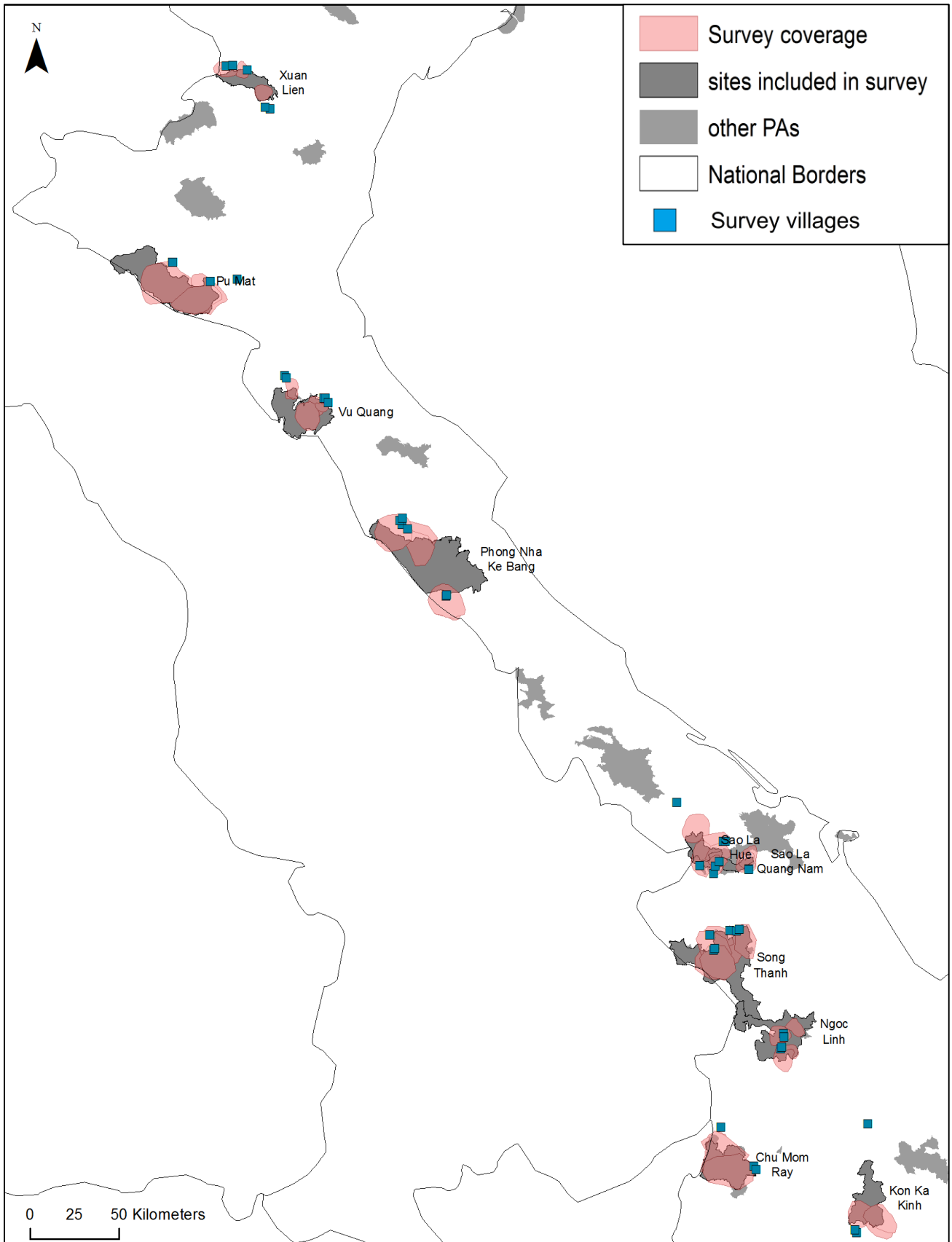


Figure 8. Map showing surveyed Protected Areas, surveyed village locations, and survey coverage in Central Vietnam.

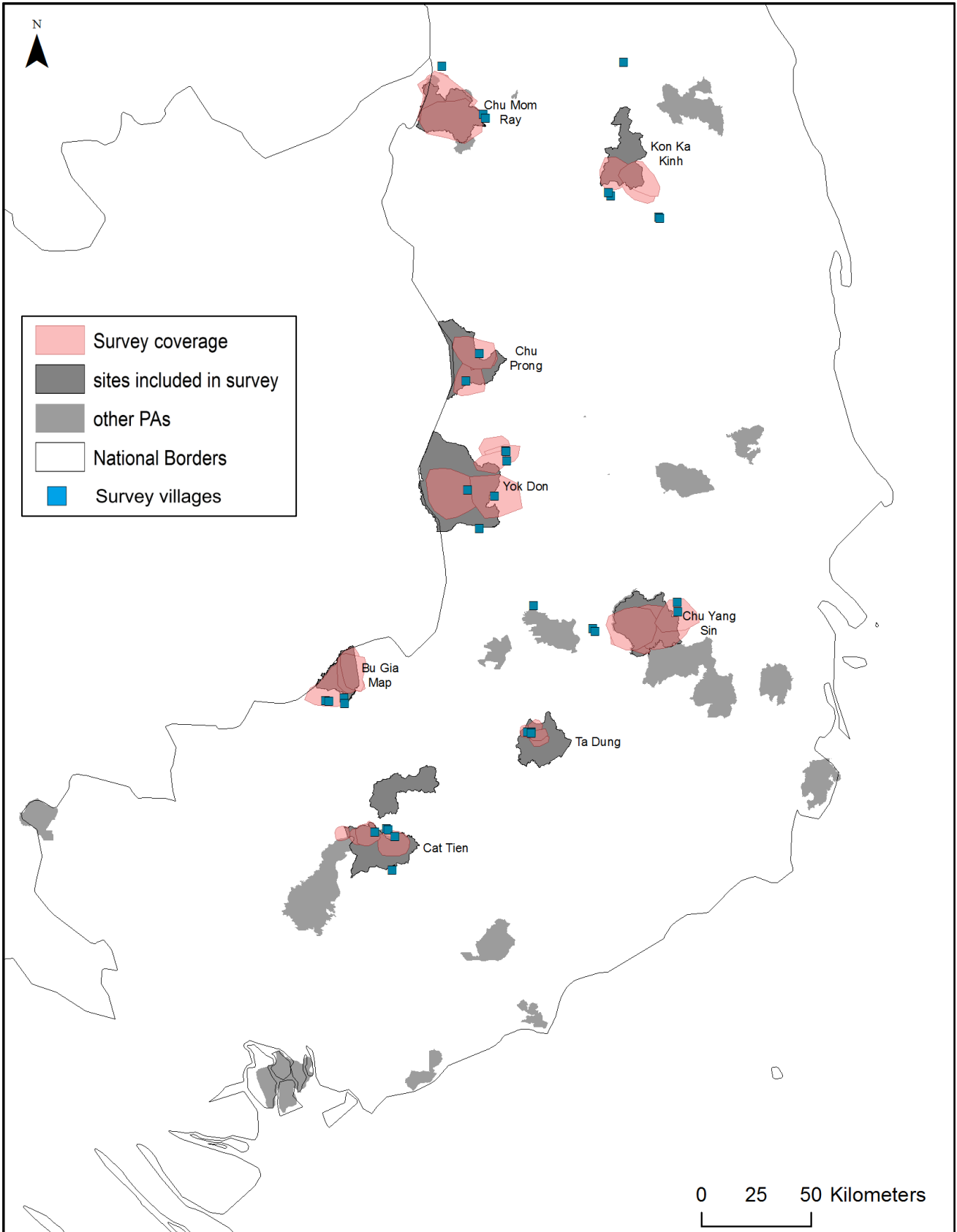


Figure 9. Map showing surveyed Protected Areas, surveyed village locations, and survey coverage in Southern Vietnam.

More men (87%, n = 1250) than women were interviewed (gender was not recorded for two respondents). The average age of respondents was 49 years (SD±11.01, n = 1439), and they lived in their village an average of 39 years (SD±17.12, n = 1418). Most had lived in the same village for more than 35 years (62%, n = 872), and most others for 20 to 35 years (23%, n = 327). Fewer moved to the village less than 20 years ago (15%, n = 219).

Twenty-two ethnic groups were included in the survey. Most respondents self-identified as Kinh (18%, n = 259), Thai (16%, n = 235), Katu (14%, n = 202), Hmong (11%, n = 156), and Mnong (7%, n = 104).

Current status of bears

Although very few respondents considered bears to be numerous, the majority (77%) believed that bears were still present in their local forest area, (Table 3).

Table 3. Interviewees' perceptions of current bear status across all Protected Areas surveyed.

Perception of bear status	Responses	Percent of total responses
Never present	2	0.2
Present in the past	249	22.7
Few present	295	26.9
Many present	10	0.9
Present (no information on abundance)	541	49.3
Present (total)	846	77.1
Absent (total)	251	22.9
No response	344	NA

This broad pattern is the case in 20 of the 22 Protected Areas (Figure 10) with 60-100% of respondents affirming the continued presence of bears. Kon Ka Kinh National Park and Chu Prong Proposed Nature Reserve are notable exceptions, where most people thought bears were no longer present. Only one reported sighting (possibly erroneous) of a bear occurred in these two areas in the past 8 years. In Cat Tien National Park, and Song Thanh and Ngoc Linh Nature Reserves 100% of respondents believed that bears were still present. However, it may be significant that the percentage of interviewees reporting bear sightings in these places is not particularly high (Table 1).

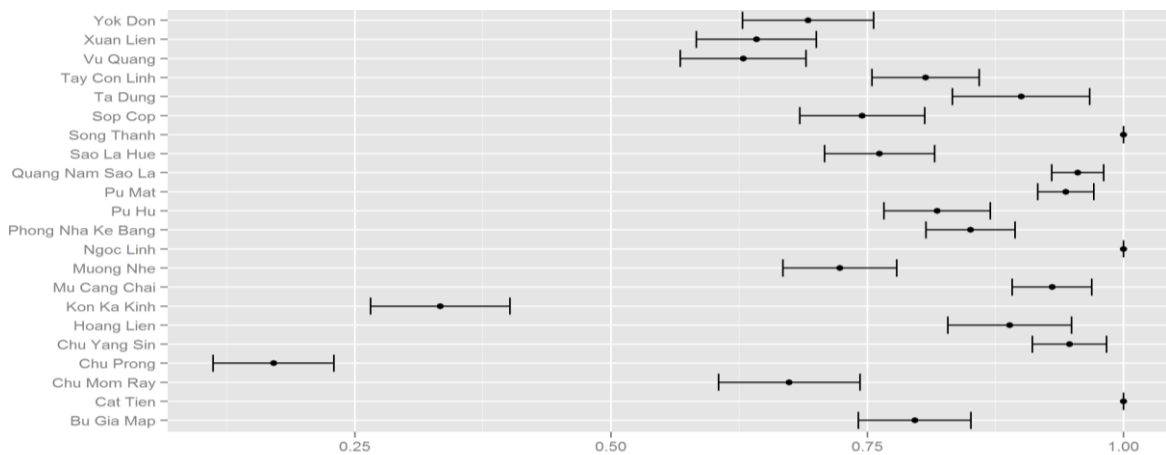


Figure 10. Proportion of respondents believing bears were still present in their local forest.

Trends in bear populations

Respondents overwhelmingly thought bears had declined in the last 10 years (798 responses; 98%). Fourteen of the 19 exceptions were from Cat Tien National Park and four from Pu Hu Nature Reserve but these represent minority opinions even at these sites. 67% of respondents at Cat Tien and 91% at Pu Hu believe bears have declined.

Dates of last sightings of bears indicate that encounter rates in the present are less than expected if bear populations were stable. These data are more consistent with declining bear populations (or another reason for a decline in reports of recent sightings; 1 tailed Kolmogorov-Smirnov goodness of fit test for discrete data; $p < 0.02$ for all sites after Holm-Bonferroni correction).

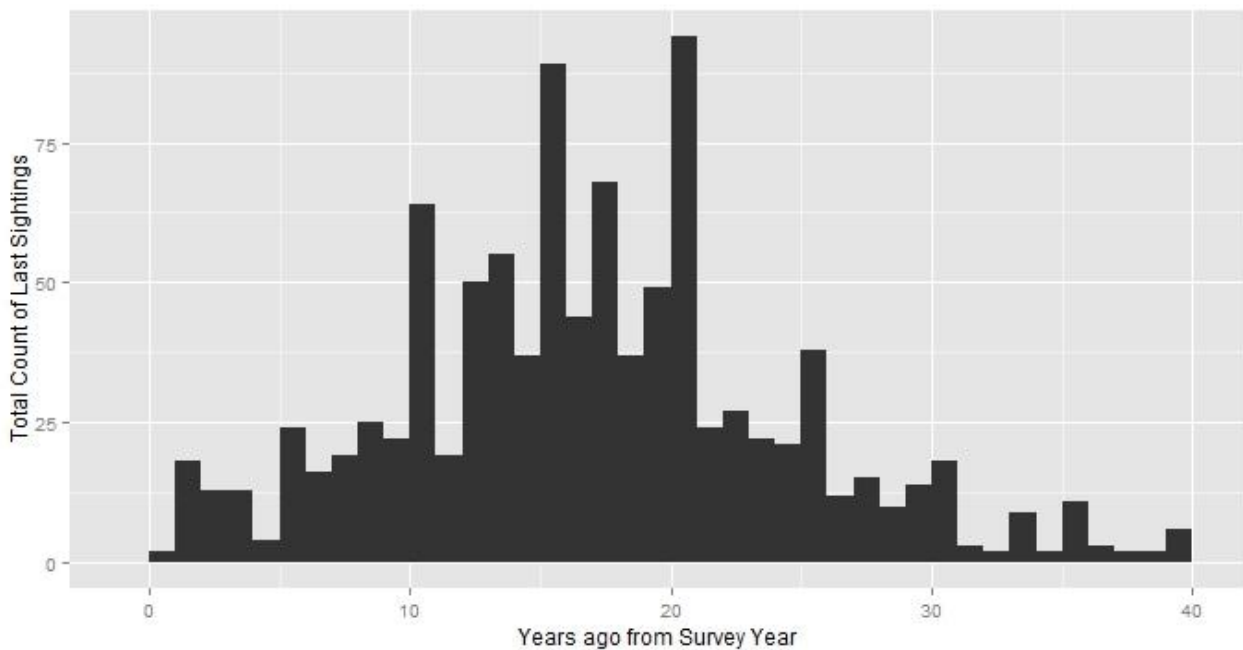


Figure 11. Combined last sightings records for all surveyed sites in Vietnam. The graph peaks approximately 20 years ago from the survey date, i.e. 1995.

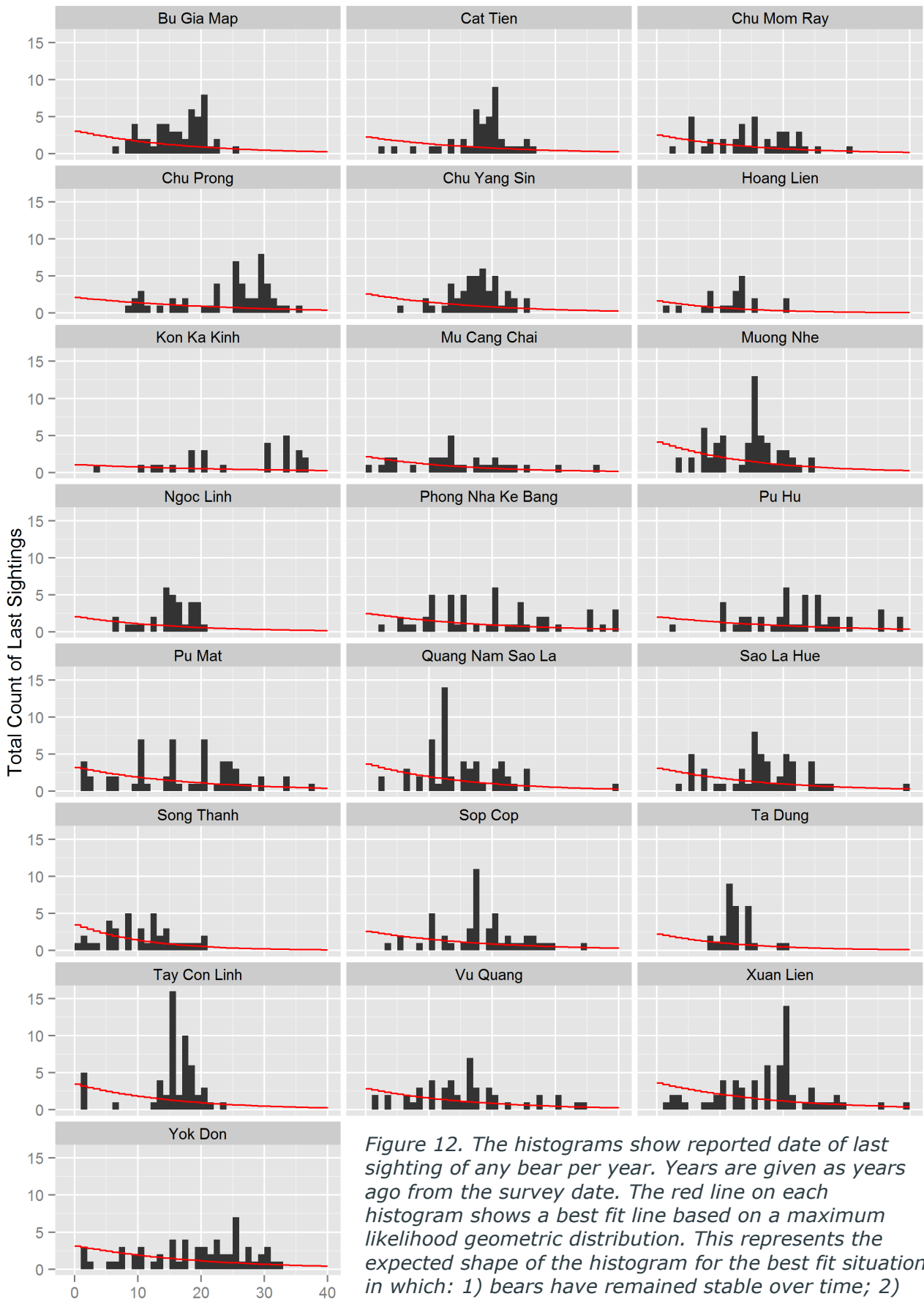


Figure 12. The histograms show reported date of last sighting of any bear per year. Years are given as years ago from the survey date. The red line on each histogram shows a best fit line based on a maximum likelihood geometric distribution. This represents the expected shape of the histogram for the best fit situation in which: 1) bears have remained stable over time; 2) sighting rates of bears have also remained stable; 3) interviewees have provided accurate information about last sighting times.

Dates when declines started

Interviewees who stated that bear populations had declined tended to think that the declines began between 1990 and 2005 (Figure 13). An exception was Kon Ka Kinh National Park where respondents indicated that bear populations began to decline in the early 80's. In Song Thanh Nature Reserve, no one gave an opinion on the timing of decline.

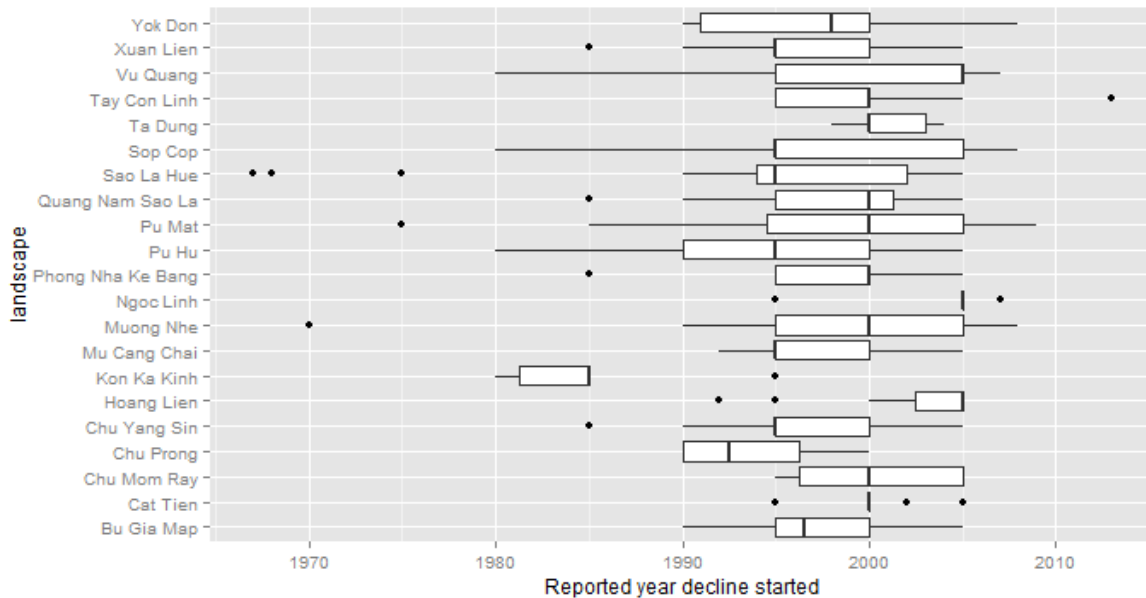


Figure 13. Boxplot showing median and inter-quartile range of year in which interviewees reported bear populations to have begun to decline. Note: only includes cases where an exact year is provided, not a range.

As noted above (Table 3), some interviewees believed bears to have been locally extirpated. Even where this is not the case (it was a minority opinion in all but two Protected Areas) the perception of extirpation may indicate a time when bears became much rarer. The pattern is similar to that in Figure 14; extirpations are thought to have occurred between 1995 and 2005. At five sites no interviewee believed that bears had been extirpated: Cat Tien National Park, Ngoc Linh Nature Reserve, Quang Nam Saola Nature Reserve, Song Thanh Nature Reserve and Ta Dung Nature Reserve.

Subjectively, we assessed the year in which the histograms in Figure 12 appear to 'peak', suggesting that a decline in bear sighting rates began in that year or shortly before. These dates of peak sightings corresponded with the median year that interviewees identified declines in bear populations to have begun ($r=0.63$; $n = 21$ Protected Areas, excluding Song Thanh Nature Reserve).

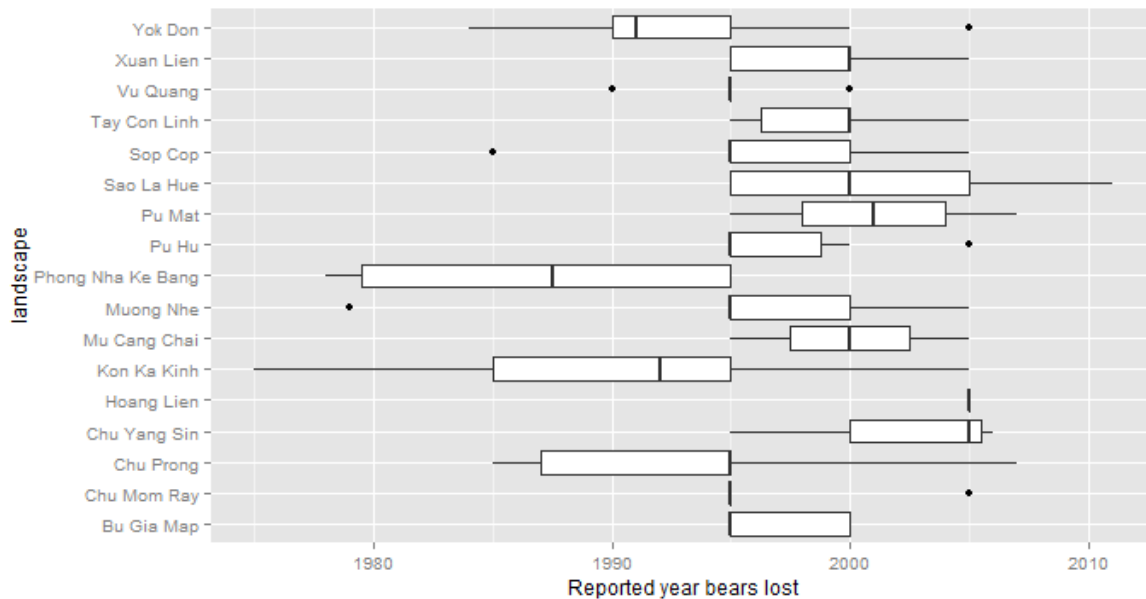


Figure 14. Boxplot showing median and inter-quartile range of year in which interviewees report bear populations to have been extirpated. Note: only includes cases where an exact year provided, not a range.

Causes of bear population decline

Among the 98% of respondents who thought bear populations had declined, there was an overwhelming opinion that hunting (including trapping) was the cause. When listing reasons, hunting was listed far more than any other reason and was usually mentioned before other reasons (Figure 15). When Protected Areas were considered separately, hunting was given as the first-mentioned reason by the majority of interviewees at 18 out of 22 Protected Areas. The exceptions were Chu Prong proposed Nature Reserve, Ngoc Linh Nature Reserve, Song Thanh Nature Reserve and Ta Dung Nature Reserve. At Chu Prong and Song Thanh, very few people (5 and 3 respectively) gave any opinion on trend. At Ngoc Linh and Ta Dung (and also Chu Prong) many answers focused on human population increase and unspecified actions of people. There is therefore nothing from these four sites which conflicts with the overall picture.

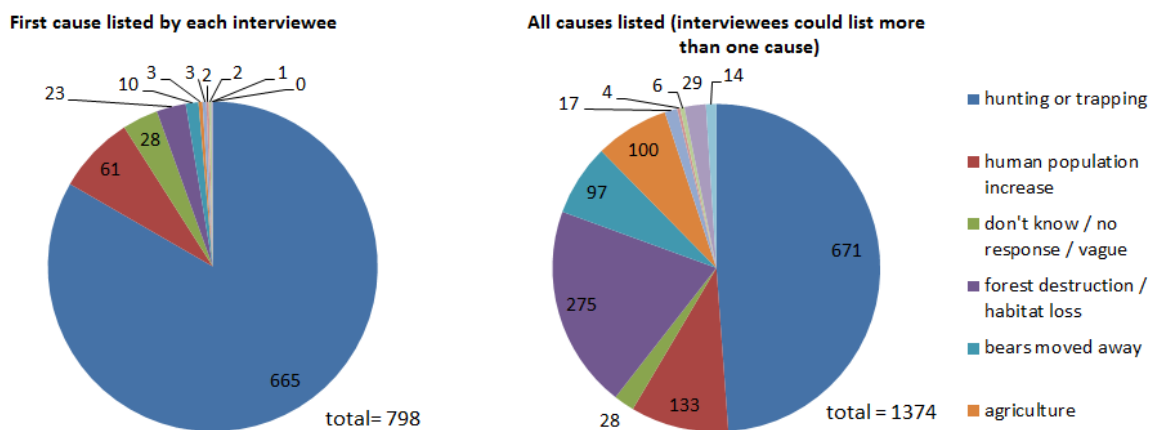


Figure 15. Causes of bear population declines, according to interviewees.

The 19 people who thought bear populations were increasing or stable mostly gave Protected Area establishment and 'forest protection' as the reasons. One respondent at Cat Tien cited the establishment of the bear rescue centre as the reason for a stable or increasing bear population at the site, although this centre does not protect wild bears directly.

Differentiating between Asiatic black bears and Sun bears

Respondents generally reported the presence of either one type of bear (27%, n = 389) or two types of bear (62%, n = 890), although a small number of people reported three types of bear (6%, n = 87) or four types of bear (0.1%, n = 2). Others reported that there were no bears present at the site (4%, n = 56) or said they did not know (1%, n = 17). One site, Tay Con Linh Nature Reserve in Ha Giang Province on the border with China, is east of the Red River and is outside the recognised historical distribution of Sun bears. There the majority of interview respondents (97%, n = 58) reported that there was only one type of bear present. The remaining respondents (3%, n = 2) said that there were no bears present.

Respondents provided Vietnamese language names for the types of native bear they recognised. Gấu ngựa, (horse bear) was the most commonly provided name (37%, n = 930). The second most commonly reported name was gấu chó, (dog bear) (35%, n = 880). In Vietnamese scientific texts these names refer to *U. thibetanus* and *H. malayanus* respectively but local usage is likely to differ and the descriptions given by interviewees suggest this was the case. Gấu lợn (Pig bear; gấu lợn or gấu heo) was also a common name (7%, n = 168), often used to refer to a third 'species' in addition to the two mentioned above. Other names provided in the Vietnamese language included: gấu đen (black bear) (3%, n = 73); gấu nhỏ (small bear) (3%, n = 64); gấu to (big bear) (2%, n = 45); and gấu đỏ (red bear) (0.4%, n = 9) and simply gấu (bear) (12%, n = 293). In addition, we recorded a great variety of names in local languages.

The relationship between the local names and scientifically recognised species is unclear. Depending on the local custom or individual understanding, Sun bears (*H. malayanus*) may be referred to in Vietnamese as Horse bear, Pig bear, Dog bear or some other variant. To distinguish between species, respondents were asked to describe the physical characteristics of each type of bear that they recognised. These descriptions were translated into English and classified by one observer as *H. malayanus*, *U. thibetanus*, bear of unknown species, or not a bear. However, the chance of misidentification remains high and so we have not attempted to distinguish the species here.

We have no reason to believe that there is a third species of bear in Vietnam. Only one instance of suspected hybridisation between wild Asiatic black bear and Sun bear has been recorded (Galbreath et al., 2008), and it is unlikely that hybridisation occurs frequently enough to give rise to the widespread, albeit vague, belief in a third species of bear in Vietnam. A more probable scenario is that the three names, Horse bear, Dog bear and Pig bear, were introduced generations ago by traders from China, which has native populations of Asiatic black bear, Sun bear, and Brown bear.

Discussion

The evidence presented here indicates that bear populations have declined throughout Vietnam, with declines apparently starting within 5 years of the year 2000 in almost all Protected Areas. There is no site without clear evidence of a decline, or where the majority of most recent sightings occurred in the last 10 years. This trend is in keeping with what has been found throughout the region. Wildlife populations have declined precipitously throughout Southeast Asia since the 1980s and many species are now extirpated from much of their former ranges (Harrison et al., 2016). Overhunting driven by improved access to forests and markets, improved technologies for hunting such as wire snares, and consumer demand for meat and medicinal products derived from wild animals is the greatest immediate threat to most of the endangered vertebrates in the region (Harrison et al., 2016). However, the 'humped' distribution of bear sightings in Figures 11 and 12 suggests stronger declines and/or smaller populations than were found in an equivalent, smaller-scale survey of ungulate species in Central Vietnam and Laos (Turvey et al., 2015).

High-value species and species captured for commercial breeding such as bears are particularly targeted by hunters. Steinmetz (2011) found that it required twice the camera trap survey effort to detect Asiatic black bears than it did Sun bears, indicating that Asiatic black bears occur at lower densities than Sun bear in the seasonally dry forests of Southeast Asia. This disparity may be as a result of long-standing commercial hunting which preferentially targeted Asiatic black bears as the most valued bear species in Traditional Medicine (Steinmetz, 2011).

There is no indication from the data that there are any strongholds for bear populations anywhere in Vietnam. There are no sites where sighting rates are markedly high, or where the data suggest anything other than a sustained population decline. On the positive side, however, there are only two out of our 22 sites where the evidence clearly suggests extirpation. At most sites, occasional reported sightings continue into recent years or to the present (Figure 12). Surveys in Thailand, showed that despite depressed populations, bears remained widely distributed throughout the country (Vinitpornsawan et al., 2006). It is therefore plausible that bears remain widely distributed at depressed population sizes, as appears to be the case in Thailand. Such 'populations' may be extremely small. A single escaped or wandering Gaur (*Bos gaurus*) in Bach Ma National Park in Central Vietnam generated numerous sighting reports by local people (Turvey et al. 2015). Apart from the evidence of decline from this survey, the conclusion that very few bears remain is supported by the findings of the limited number of bear sign surveys and camera trap surveys for bears that have been conducted in Vietnam to date (Scotson et al., 2009; Crudge et al., 2016).

The timing of the reported bear population declines appears similar across most sites in Vietnam, with respondents indicating that the declines began between 1990 and 2005. This is supported by the distribution of last sightings dates. The humped/peaked distribution in last sighting dates at all sites suggests a marked decline either in bear population size or sighting rate, or both, at all sites. The modal value for last sightings is approximately 20 years ago from the survey date (i.e. 1995; Figures 11 and 12). This coincides with the time at which bear bile farming in Vietnam began to expand rapidly.

With a bear population decline beginning 20 years ago, as indicated by the peak date of last sightings, Cat Tien National Park is considered an "average" site. In Chu Prong Proposed Nature Reserve, Kon Ka Kinh National Park, and Yok Don National Park sightings peaked more than 20 years ago, whereas sighting data in Song Thanh Nature Reserve, Ngoc Linh Nature Reserve, Quang Nam Saola Nature Reserve and Hue Saola Nature Reserve suggest that bear populations started to decline more recently. This conclusion is supported by the proportion of people who believe that bears are still present, which was low in the sites where sightings peaked long ago (Chu Prong and Kon Ka Kinh) and higher at sites with more recent sightings (Song Thanh, Ngoc Linh, Quang Nam Saola, and Pu Mat).

The proportion of people believing that bears are still present in Cat Tien National Park was high compared to the proportion of people reporting having seen a bear. The results of recent bear sign surveys and camera trap surveys do not indicate that Cat Tien National Park has a significant bear population (Scotson et al., 2009, Crudge et al., 2016). The presence of a bear rescue centre in Cat Tien National Park, or its status locally as a famous national park, or the fact that there have been recent bear surveys, may bias peoples' perception of bear population status at the site, even if they haven't actually seen a bear in the forest.

As noted in the introduction, information from interviews can never be entirely reliable. We would like to draw attention to three particular caveats affecting our interpretations. Firstly, a decline in sighting rates of bears may have other causes than a decline in bear populations. One possibility is that a "gold rush" for bears, occurred 20 years ago fueled by new technologies (wire snares) and new market demand (bear bile farms) and that the peak in sightings at that time in fact refers to bears that the interviewees hunted themselves. Subsequently, demand for bear bile might have declined or, as bear populations declined and the skill or time required to hunt bears increased, bear hunting might have become a more specialized activity among the local population and sighting rates declined for this reason. If this is so, it is possible that the histograms in Figure 12 provide exaggerated evidence for declines although this is probably not the case for the direct questions about trend.

A second caveat relates to the conclusion that bears survive at most sites. No individual interview record is reliable. Even if interviewees are honest and are reporting genuine bear sightings, they may still have mis-remembered the date at which they occurred. It is therefore important to be cautious when inferring persistence on the basis of one or two recent records (Solow et al., 2012).

A third caveat relates to the conclusion that there is no stronghold for bears at which healthy populations persist. Our survey was not entirely comprehensive and, as revealed by Figures 7 - 9, some remote areas of certain Protected Areas were left uncovered by the survey due to the difficulty in finding interviewees with knowledge of these areas. It is always possible that there is still some area, perhaps in the heart of Phong Nha-Ke Bang National Park or Muong Nhe Nature Reserve where bears are markedly more abundant than elsewhere. However, we do not see any reason to expect this.

Some of the additional data we collected in our survey will allow us to better investigate the likely importance of these confounding factors in the future.

Conclusion

Wild bear populations throughout Vietnam began to decline precipitously approximately 20 years ago (i.e. 1995), driven by hunting and trapping. The timing of the population decline coincides with the rapid expansion of bear bile farming in Vietnam. In 1999 there were an estimated 446 bears being kept illegally in Vietnam (Nguyen, 2006). By 2005 this number had increased to 4,012 individuals, an annual increase of about 600 live bears per year. Taking into account the number of bears that would have died on the farms during that time, as well as the number that would have died during capture (Figure 16), it is estimated that as many as 1,000 wild bears were captured or killed per year during this time just to stock farms in Vietnam (Nguyen, 2006), in addition to those that were trafficked across international borders, or remained on farms unreported. The timing of bear population declines observed here is evidence that bear farming in Vietnam and access to new technologies spurred increased hunting pressure on wild bears in a poaching free-for-all fuelled by heightened demand, access to new markets, and the allure of financial profits. In 1995 Vietnam's economy was growing rapidly, creating new ranks of urban wealth while approximately 50% of the population lived below the poverty line (Womack, 1996). By 1999, a poached bear could be worth more than 1,000 USD (Servheen, et al., 1999), well above the GDP per capita level for that time (<\$800USD). Meanwhile, enforcement of laws was severely lacking and failed to deter illegal domestic or international trade in bears and bear parts (Shepherd and Nijman 2008; Foley et al., 2011; Burgess et al., 2014). Low risk of being caught, even lower risk of being prosecuted, and high potential profits created a strong incentive to hunt and trade bears. Evidence indicates that bear bile farming in Vietnam has not supplanted, and has possibly increased, demand for wild bile (Drury, 2009). When there is a consumer preference for wild animal products, farmed products cannot offer a substitute, and illegal hunting will remain a threat (Tensen, 2016). Trade in live bears to stock bile extraction facilities, as well as trade in parts and derivatives, such as gallbladders and bile, is widespread throughout the region and has driven declines in bear populations (Foley et al., 2011; Livingstone and Shepherd, 2014; Burgess et al., 2014).

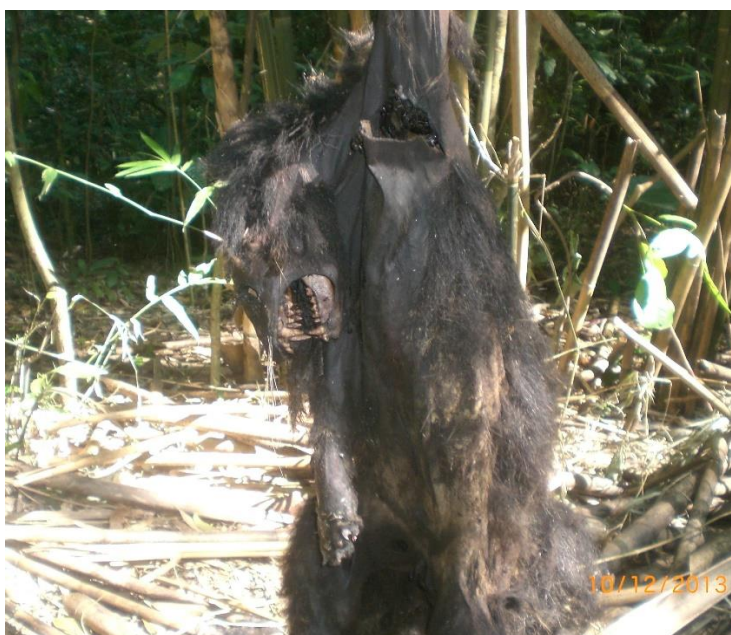


Figure 16. Carcass of an Asiatic black bear that was caught and died in a snare in Nam Kan National Protected Area, northern Laos. This bear, and presumably many more, died before poachers could take it from the forest and sell it to a bile farm.

While nowhere in Vietnam stands out as a stronghold for bear populations, bears still persist across the country. Camera trap images have confirmed the presence of Asiatic black bears in Mu Cang Chai Species and Habitat Conservation Area in Yen Bai Province, and in Cao Vit Gibbon Conservation Area in Cao Bang Province, in 2014 (B.M. Rawson, FFI Vietnam, pers. comm, August 2016). Persistence of bears is also evidenced by ongoing hunting and capture of live bears. Between 2007 and 2015, 32 Asiatic black bears and four Sun bears, all younger than one year, were confiscated from the illegal trade and transferred to Animals Asia's care in the Vietnam Bear Rescue Centre, Tam Dao (Animals Asia, unpublished data). In 2014 a juvenile Asiatic black bear was caught in a snare in Chu Mom Ray National Park (WAR, 2014), and one captive Sun bear was discovered in Ha Tinh Province during the current survey, with the tell-tale missing paw; it was reportedly caught with a snare in 2015 near the Laos-Vietnam border (Figure 17).



Figure 17. Juvenile Sun bear discovered in a village in Ha Tinh Province during the survey, with the tell-tale missing paw, it was reportedly caught with a snare in 2015 near the Laos-Vietnam border.

In 2014, WWF confirmed the presence of Asiatic black bear in Quang Nam Saola Nature Reserve in Quang Nam Province in Central Vietnam, with a camera trap image that due to its rarity made national headlines (Figure 18) (WWF, 2014). This image however does not imply that Quang Nam has a thriving bear population. The project, which ran from 2012 to 2014, had a relatively high survey effort and in addition to two images of bears, also captured images of the Critically Endangered Sunda pangolin (*Manis javanica*), the Data Deficient Annamite striped rabbit (*Nesolagus timminsi*), and the Critically Endangered Saola (*Pseudoryx nghetinhensis*) – a species not sighted in Vietnam for 15 years (WWF, 2014; WWF 2013b). Biodiversity surveys in Xe Sap National Protected Area, in Salavan and Xekong provinces in southern Laos, adjacent to the Quang Nam and Hue Saola Nature Reserves showed that populations of almost all threatened large mammals, including bears, have been severely depleted since the 1990s (Gray et al., 2013). The individual bears detected by camera trap or caught by poachers over the past few years may represent the last remnants of populations with little to no prospect of recovery without immediate investment in conservation intervention such as protection and/or translocation.

Bear populations have the ability to recover in previously extirpated areas (Oi & Yamazaki, 2006; Fredriksson, 2012). In Indonesian Borneo, Sun bear populations were monitored in forest affected by fire and in adjacent unburned forest. In recently burned forest the density of bear sign was close to zero. However, within 10 years sign density had increase to 65% of that in the adjacent unburned forest (Fredriksson, 2012). Wild bear populations in Vietnam, where they persist, clearly occur well below natural carrying capacity and in isolated forest patches. Given the lack of nearby source populations within Vietnam, the recovery of bear populations will require increased connectivity and protection of sites in neighbouring Cambodia and Laos. Unlike population restoration of other large carnivores such as Tigers (*Panthera tigris*) which require a large and stable prey-base (O'Kelly et al., 2012), the population restoration of the omnivorous bears would require fewer conservation resources and could provide important lessons for the recovery of more globally threatened species.

Although no single site in Vietnam appears to offer great prospects for bear conservation, based on the evidence presented here, Quang Nam Province offers some hope in that it encompasses two Protected Areas that the data suggest are relatively good for bears: Quang Nam Saola Nature Reserve and Song Thanh Nature Reserve. In Vietnam much of the responsibility for Protected Area management has been devolved from central government to provincial or even district authorities among whom biodiversity conservation is not always a priority, resulting in virtually no coordination of conservation efforts throughout the Protected Area network (Brunner, 2012). It is often therefore more practical to implement conservation at the local site or provincial level. The conservation potential of Quang Nam Province is enhanced by its central position within the Annamite Mountains, an area of global conservation importance due to its high species richness and endemism (Sterling and Hurley, 2005). Ngoc Linh Nature Reserve has a sector in Quang Nam and a sector in Kon Tum Province. While the former was not surveyed in this project, data suggests that the latter is relatively good. Kon Tum Province also contains Chu Mom Ray National Park which also ranked highly.

While it is not impossible that a site exists which harbours a substantial bear population, we consider the probability too low to make further search worthwhile. Any site with recent confirmed records of bears, e.g. Mu Cang Chai Species and Habitat Conservation Area, Cao Vit Gibbon Conservation Area, should be considered for protection activities and future research. However, at sites with no recent certain records, targeted surveys could be conducted to confirm bear presence. Therefore, efforts to conserve bears in the wild in Vietnam should prioritize sites primarily on the basis of factors such as the state of the current conservation infrastructure at the site and the proximity to major markets for bile. These factors are likely to be more important in determining conservation success than current bear population size. Research could include population and habitat assessments in order to identify the relative conservation importance of the site, identify ongoing and immediate threats, and develop a site-based action plan for the conservation of bears.



Figure 18. Camera trap image of Asiatic black bear in Quang Nam Saola Nature Reserve in 2014. © WWF-Vietnam / CarBi / Quang Nam Saola Nature Reserve.

A nationwide survey of bear distribution was recommended as a priority action for the conservation of bears in Vietnam in 1999 (Servheen, et al., 1999), at a time when bear bile farming was in its infancy in Vietnam. In the years that followed, no such surveys were conducted, bear bile farming expanded rapidly and largely unimpeded by regulation, and, as this study shows, wild bear populations in Vietnam declined dramatically. If the recommended actions had been implemented in a timely manner, the authorities and the public may have been alerted to the unsustainable scale of poaching driven by bear bile farming, and had the evidence and time necessary to halt and potentially reverse the decline of bear populations in Vietnam.

The recommendations detailed below should be implemented immediately if we are to halt the decline of bear populations in the region and prevent bear numbers from declining further in Vietnam.

Recommendations

- This study indicates that the establishment of bear bile farming in Vietnam had no positive, and more likely extremely detrimental, impact on the conservation of wild bears. Vietnam should continue strengthening efforts to phase out bear bile farming completely.
- The Traditional Medicine community in Vietnam has committed to phasing out the use of bear bile products by 2020. Government and non-government partners should assist the Traditional Medicine community in promoting the use of herbal and synthetic alternatives to bear bile.
- Latest figures indicate that around 1,200 bears remain in bile farms and private households in Vietnam. For as long as bear bile farms exist in Vietnam it is possible that further pressure will be placed on wild bear populations. In order to hasten the phasing out of bear bile farming in Vietnam, the Ministry of Agriculture and Rural Development, in collaboration with partner NGOs, should conduct a thorough and rapid assessment of all remaining facilities, to determine the exact number of bears remaining, their ages, physical conditions and veterinary requirements. A management strategy should then be developed to rehome and provide life-long care for the bears in sanctioned rescue facilities as soon as possible. Rescue facilities should receive the governmental and financial support necessary to receive bears in a timely manner.
- Asiatic black bears and Sun bears are listed as CITES Appendix I species, thereby prohibiting international commercial trade in whole animals, parts, or derivatives. Concerted efforts should be made while phasing out bear bile farming in Vietnam to ensure that it does not result in bears being trafficked illegally to neighbouring countries to facilitate the growth of or supplement the bear bile farming industry beyond Vietnam's borders.
- The detrimental impacts of commercial wildlife farming, as clearly demonstrated by the case of bear bile farming in Vietnam and the almost complete loss of wild bears, should serve as a warning to those considering commercial farming of bears and other species for conservation purposes in Vietnam and beyond. Any state considering commercial wildlife farming as a conservation strategy should conduct a thorough assessment of wild populations and determine what level of off-take, if any, would be sustainable on a species-by-species basis before engaging in such a potentially disastrous strategy. Stringent monitoring is required and if evidence suggests that sustainable levels of off-take have been surpassed then a moratorium should be enacted immediately to prevent further harvesting from wild populations.
- Quang Nam and adjacent Kon Tum Provinces encompass four study sites that have been identified as offering comparatively good potential for wild bear conservation. Investment should be made in protection and research activities at these sites. NGOs should engage at the provincial level in order to conserve the priority sites of Song Thanh Nature Reserve (Quang Nam Province), Quang Nam Saola Nature Reserve (Quang Nam Province), and Chu Mom Ray National Park (Kon Tum Province). Conservation of bears in Ngoc Linh Nature Reserve, which has sectors in both provinces, would benefit from a unified strategy and investment in bear conservation, including further research, law enforcement patrols, and community outreach.

- An assessment of bear population status and threats in Dong Amphan National Park, Attapeu Province in southern Laos, should be conducted immediately in order to assess its connectivity to, and potential to provide source populations and habitat connectivity to, the priority sites of Chu Mom Ray National Park and Ngoc Linh Nature Reserve in Kon Tum Province, as well as the adjacent Song Thanh Nature in Quang Nam Province.

- Hunting and trade in bears and their parts is ongoing in violation of national laws and international conventions. Individuals caught illegally collecting, selling, buying, transporting or keeping bears or their parts or derivatives, should be prosecuted to the full extent of the law. Prosecutions should be publicised on national media and penalties should be severe enough to serve as a deterrent to individuals in the future.

- Ongoing trade in bears and their parts is a severe threat to Vietnam's few remaining wild bears. Relevant government agencies should support and collaborate with local and international organizations to conduct campaigns throughout Vietnam to end the illegal consumption of bear bile products. The results of this project should be used for demand reduction campaigns in the urban centres of Vietnam, and used in site-based conservation projects to educate local people about the conservation importance of their respective sites and develop a sense of pride in species conservation.

- Bear sign and camera trap surveys should be conducted at selected sites sampled in this study in order to confirm the continued presence of bears at the sites and identify a long-term monitoring plan.

References

- Animals Asia, 2015. Protected species dying on a mass scale in Vietnam
<https://www.animalsasia.org/intl/media/news/news-archive/protected-species-dying-on-a-mass-scale-in-vietnam.html> Accessed: 08th Feb 2016.
- Arnold, T. B., and J. W. Emerson, 2011. Nonparametric Goodness-of-Fit Tests for Discrete Null Distributions. *The R Journal* 3:34–39.
- Brunner, J. 2012. Biodiversity conservation in Vietnam: A Perfect Storm. IUCN paper.
https://cmsdata.iucn.org/downloads/iucn_nbsap_workshop_march_2012_paper_final.pdf Accessed 22nd July 2016.
- Burgess, E. A., Stoner, S. S., and Foley, K. E., 2014. Brought to bear: an analysis of seizures across Asia (2000–2011). *TRAFFIC: Petaling Jaya, Selangor, Malaysia*.
- Cano, L. S., and Tellería, J. L., 2013. Local ecological knowledge as a tool for assessing the status of threatened vertebrates: a case study in Vietnam. *Oryx*, 47(02), 177-183.
- Chaudhry P., and Ruyschaert G., 2007. Climate Change and Human Development in Viet Nam: A case study for the Human Development Report 2007/2008, UNDP, Hanoi, Vietnam, 2007.
- Choulakian, V., Lockhart, R., and Stephens, M., 1994. Cramér-von Mises statistics for discrete distributions. *Canadian Journal of Statistics* 22:125–137.
- CITES, 2016a. Checklist of CITES species.
http://checklist.cites.org/#/en/search/output_layout=alphabetical&level_of_listing=0&show_synonyms=1&show_author=1&show_english=1&show_spanish=1&show_french=1&scientific_name=ursus&page=1&per_page=20 Accessed: 12th August 2016.
- CITES, 2016b. List of Contracting Parties.
https://cites.org/eng/disc/parties/chronolo.php?order=field_country_official_name&sort=asc Accessed: 12th August 2016.
- Crudge, B., Phạm V.T., Lim, T., and Schneider, M., 2016. Cat Tien National Park wild bear population survey report. Free the Bears, Technical Report.
- Drury, R., 2009. Reducing urban demand for wild animals in Vietnam: examining the potential of wildlife farming as a conservation tool. *Conservation Letters*, 2(6), 263-270.
- Dutton, A. J., Hepburn, C., and Macdonald, D. W., 2011. A stated preference investigation into the Chinese demand for farmed vs. wild bear bile. *PloS one*, 6(7), e21243.
- ENV, 2015. An Analysis of Change in Bear Bile Use in Vietnam. Education for Nature - Vietnam.

- ENV, 2016. Education for Nature – Vietnam, Wildlife Protection Law Resource Centre. <http://envietnam.org/index.php/news-resources/library#decree160> Accessed: 12th August 2016
- Foley, K. E., Stengel, C. J., and Shepherd, C. R., 2011. Pills, powders, vials and flakes: The bear bile trade in Asia. TRAFFIC Southeast Asia.
- Galbreath, G.J., Hunt, M., Clements, T., and Waits, L.P., 2008. An apparent hybrid wild bear from Cambodia. Short Communication, *Ursus* 19(1):85-86.
- Garshelis, D.L., and Scotson, L., 2012. World conservation congress votes to curtail bear farming. *International Bear News* 21:12-16.
- Gray, T.N.E., Calame, T., Hayes, B., Hurley, M.J., Nielsen, P.H., Vichith Lamxay, Timmins, R.J., and Khamhou Thongsamouth., 2013. Biodiversity Surveys of Xe Sap National Protected Area, Lao PDR 2012. WWF Greater Mekong, Vientiane, Lao PDR, February 2013.
- Hagey, L. R., Crombie, D. L., Espinosa, E., Carey, M. C., Igimi, H., and Hofmann, A. F., 1993. Ursodeoxycholic acid in the Ursidae: biliary bile acids of bears, pandas, and related carnivores. *Journal of Lipid Research*, 34(11), 1911-1917.
- Harrison, R.D., Sreekar, R., Brodie, J.F., Brook, S., Luskin, M., O'Kelly, H., Rao, M., Scheffers, B. and Velho, N., 2016. Impacts of hunting on tropical forests in Southeast Asia. *Conservation Biology*.
- Islam, M.A., Uddin, M., Aziz, M.A., Muzaffar, S.B., Chakma, S., Chowdhury, S.U., Chowdhury, G.W., Rashid, M.A., Mohsanin, S., Jahan, I. and Saif, S., 2013. Status of bears in Bangladesh: going, going, gone?. *Ursus*, 24(1), pp.83-90.
- IUCN, 2012. Resolutions and Recommendations: World Conservation Congress. IUCN, Gland, Switzerland.
- IUCN, 2016a. (IUCN/SSC Bear Specialist Group). *Helarctos malayanus*. The IUCN Red List of Threatened Species 2016. *In prep*.
- IUCN, 2016b. (IUCN SSC Bear Specialist Group). *Ursus thibetanus*. The IUCN Red List of Threatened Species 2016. *In prep*.
- Japan Bear Network (compiler), 2006. Understanding Asian Bears to Secure Their Future. Japan Bear Network, Ibaraki, Japan. 145pp.
- Keane, A., 2013. Unusual data in conservation science: searching for validation. *Animal Conservation* 16:604–605.
- Kim, Y-K., Y-J. Hong, M-S. Min, K. S. Kim, Y-J. Kim, I. Voloshina, A. Myslenkov, G. J. D. Smith, N. D. Cuong, H. H. Tho, S-H. Han, D-H. Yang, C-B. Kim, and H. Lee., 2011. Genetic status of Asiatic black bear (*Ursus thibetanus*) reintroduced into South Korea based on mitochondrial DNA and microsatellite loci analysis. *Journal of Heredity* 102: 165–174.

- Livingstone, E., and Shepherd, C. R., 2016. Bear farms in Lao PDR expand illegally and fail to conserve wild bears. *Oryx*, 50(01), 176-184.
- Liu, F., McShea, W., Garshelis, D., Zhu, X., Wang, D., Gong, J. E., and Chen, Y., 2009. Spatial distribution as a measure of conservation needs: an example with Asiatic black bears in south-western China. *Diversity and Distributions*, 15(4), 649-659.
- MARD, 2014. Vietnam's Fifth National Report to the United Nations Convention on Biological Diversity Reporting Period: 2009–2013. Ministry of Natural Resources and Environment, Hanoi, 2014.
- McElwee, P. D., 2008. Forest environmental income in Vietnam: household socioeconomic factors influencing forest use. *Environmental conservation*, 35(02), 147-159.
- Nash, H. C., Wong, M. H., and Turvey, S. T., 2016. Using local ecological knowledge to determine status and threats of the Critically Endangered Chinese pangolin (*Manis pentadactyla*) in Hainan, China. *Biological Conservation*, 196, 189-195.
- Nga, D.T., 2006. Economic Value of Non-Timber Forest Products for KaTu People and Future Options for Song Kon Protection Forest Management Board in Quang Nam Province, Vietnam. WWF Greater Mekong–Vietnam Country Programme, Hanoi.
- Nguyen, X. D., 2006. The current status and conservation of bears in Vietnam. In: Japan Bear Network, 2006. Understanding Asian bears to secure their future. Japan Bear Network, Ibaraki, Japan.
- Nguyen, X.D., 2007. Bear Parts Trade in Vietnam and Measures for Its Control. In: Williamson, Douglas F. (ed.). 2007. Proceedings of the Fourth International Symposium on Trade of Bear Parts, 4 October, 2006, Nagano, Japan. TRAFFIC East Asia-Japan, Tokyo.
- O'Kelly, H.J., Evans, T.D., Stokes, E.J., Clements, T.J., Dara, A., Gately, M., Menghor, N., Pollard, E.H., Soriyun, M. and Walston, J., 2012. Identifying conservation successes, failures and future opportunities; assessing recovery potential of wild ungulates and tigers in eastern Cambodia. *PloS one*, 7(10), p.e40482.
- Oi, T. and Yamazaki, K., 2006. The status of Asiatic black bears in Japan. Understanding Asian bears to secure their future, pp. 122-133. Japan Bear Network, Ibaraki, Japan.
- Quang, D. V., and Anh, T. N., 2006. Commercial collection of NTFPs and households living in or near the forests: Case study in Que, Con Cuong and Ma, Tuong Duong, Nghe An, Vietnam. *Ecological economics*, 60(1), 65-74.
- Resolution Conf. 10.8 (Rev. CoP14). <https://cites.org/eng/res/10/10-08R14.php>
Accessed: 12th August 2016.

- Robinson, J., Cochrane, G., and K. Loeffler., 2007. Discussion regarding the impacts of bear bile farming on wild bears in China and Vietnam. In: Williamson, Douglas F. (ed.). 2007. Proceedings of the Fourth International Symposium on Trade of Bear Parts, 4 October, 2006, Nagano, Japan. TRAFFIC East Asia-Japan, Tokyo.
- Robertson, S., Trung, T.C. and Moberg, F., 2003. Hunting and Trading Wildlife: an Investigation into the Wildlife Trade in and Around the Pu Mat National Park, Nghe An Province. SFNC, Vinh, Nghe An, Vietnam.
- Scotson, L., Downie, A., Bach Thanh Hai, Morkel, B., and Nguyen Thanh Long, 2009. Wild bear population status, Cat Tien National Park, Vietnam. Free the Bears, Technical Report.
- Scotson, L., 2013. The distribution and status of Asiatic black bears *Ursus thibetanus* and Sun bears *Helarctos malayanus* in Eastern Lao PDR: Nakai Nam Theun, Laving Lavern and Xe Sap National Protected Areas. Free the Bears, Technical Report.
- Servheen, C., Herrero, S., and Peyton, B. (compilers), 1999. Bears. Status Survey and Conservation Action Plan. IUCN/SSC Bear and Polar Bear Specialist Groups. IUCN, Gland, Switzerland and Cambridge, UK. x + 309 pp.
- Shepherd, C. R., and Nijman, V., 2008. The trade in bear parts from Myanmar: an illustration of the ineffectiveness of enforcement of international wildlife trade regulations. *Biodiversity and Conservation* 17, 35-42.
- Solow, A. R., W. Smith, M. Burgman, T. M. Rout, B. A. Wintle, and D. L. Roberts., 2012. Uncertain sightings and the extinction of the Ivory-billed woodpecker. *Conservation Biology* 26:180–184.
- Steinmetz, R., 2011. Ecology and distribution of sympatric Asiatic black bears and sun bears in the seasonally dry forests of Southeast Asia. pp: 249 - 274 in W. J. McShea, S. J. Davies, and N. Bhumpakphan, editors. *The Ecology and Conservation of Seasonally Dry Forests in Asia*. Smithsonian Institution Scholarly Press, Washington, DC.
- Sterling, E.J., and Hurley, M.M., 2005. Conserving Biodiversity in Vietnam: Applying Biogeography to Conservation Research. *Proceedings of the California Academy of Sciences*. 2005, Volume 56, Supplement I, No. 9, pp. 98–118.
- Taylor, B. L., and Gerrodette, T., 1993. The uses of statistical power in conservation biology: the vaquita and northern spotted owl. *Conservation Biology* 7:489–500.
- Tensen, L., 2016. Under what circumstances can wildlife farming benefit species conservation?. *Global Ecology and Conservation*, 6, pp.286-298.
- Turvey, S.T., Risley, C.L., Barrett, L.A., Yujiang, H., and Ding., W., 2012. River Dolphins Can Act as Population Trend Indicators in Degraded Freshwater Systems. *PLoS ONE* 7:e37902.

- Turvey, S.T., Trung, C.T., Quyet, V.D., Nhu, H.V., Thoai, D.V., Tuan, V.C.A., Hoa, D.T., Kacha, K., Sysomphone, T., Wallate, S. and Hai, C.T.T., 2015. Interview-based sighting histories can inform regional conservation prioritization for highly threatened cryptic species. *Journal of Applied Ecology*, 52(2), pp.422-433.
- Vinitpornsawan, S., Steinmetz, R., and Kanchanasakha, B., 2006. The status of bears in Thailand. In: Japan Bear Network, 2006. *Understanding Asian bears to secure their future*. Japan Bear Network, Ibaraki, Japan.
- Williamson, Douglas F. (ed.), 2007. *Proceedings of the Fourth International Symposium on Trade of Bear Parts*, 4 October, 2006, Nagano, Japan. TRAFFIC East Asia-Japan, Tokyo.
- Womack, B., 1996. Vietnam in 1995: Successes in peace. *Asian Survey*, 36(1), 73-82.
- WWF, 2013a. *Ecosystems in the Greater Mekong: Past trends, current status, possible futures*. WWF-World Wide Fund For Nature, Greater Mekong.
- WWF, 2013b. Rediscovery of Saola: 'Asian Unicorn' Sighted in Vietnam after 15 years. November 12, 2013. <http://www.worldwildlife.org/press-releases/rediscovery-of-saola-asian-unicorn-sighted-in-vietnam-after-15-years> Accessed: 19th Aug 2016.
- WWF, 2014. Endangered Asiatic black bear caught on camera, Posted on 31 July 2014. http://wwf.panda.org/wwf_news/?226590/Endangered-Asiatic-black-bear-caught-on-camera Accessed: 19th Aug 2016.

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