

Patterns of Bear Attacks on Humans, Factors Triggering Risky Scenarios, and How to Reduce Them

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Introduction

The media and scientific literature are increasingly reporting an escalation of large carnivore attacks on humans, mainly in the so-called developed countries, such as Europe and North America (Penteriani et al. 2016; Bombieri et al. 2018a). Although large carnivore populations have generally increased in developed countries (Chapron et al. 2014), increased numbers are not solely responsible for the observed rise in the number of attacks. For example, recent research has shown that people frequently engage in risk-enhancing behaviors that can increase the probability of a risky encounter and a potential attack, and perhaps even alter carnivore behavior (Penteriani et al. 2016, 2017; Garrote et al. 2017).

Of the eight bear species inhabiting the world, two (i.e. the Andean bear and the giant panda) have never, or very rarely, been reported to attack humans, whereas the other six species have: sun bears *Helarctos malayanus*, sloth bears *Melursus ursinus*, Asiatic black bears *Ursus thibetanus*, American black bears *Ursus americanus*, brown bears *Ursus arctos*, and polar bears *Ursus maritimus*. These species occur across four continents (Asia, Europe, North and South America) characterized by a huge range of social and cultural practices, e.g. from increasing leisure activities in bear areas in developed countries to daily forest works in developing countries. Such differences in the use of bear habitats by people may determine that different scenarios trigger bear attacks on humans around the world. However, even if the motivations that determine human presence in bear countries and risky encounters with bears are diverse, some triggering factors might be common in activating bears' dangerous reactions toward people, e.g. inappropriate human behaviors when sharing the landscape with bears or when encountering them at close range.

This chapter provides insights into the causes, and as a result the prevention, of bear attacks on people. Prevention and information that can encourage appropriate human

behavior when sharing the landscape with bears are of paramount importance to reduce both potentially fatal human-bear encounters and their consequences to bear conservation.

Methods

We reviewed scientific/gray literature and analyzed personal databases on bear attacks on humans available from 1980 to 2018. Moreover, we also searched for PhD/MSc theses and webpages on bear attacks on humans. In addition, we collected news reports from online newspapers to complete the data set obtained from the above-mentioned sources. To this aim, for each bear species and area, we searched for news articles on Google on an annual basis using the following combination of words: “species name” + “attack” and “species name” + “attack” + “human.” To prevent duplicate records in the data, we cross-checked information such as date, locality, and human characteristics. When possible, for each attack, we recorded the following information: (1) period of the attack, i.e. year, month, and time of the day; (2) location; (3) outcome, i.e. human injury or death; (4) characteristics of the person/party and bear involved in the attack, e.g. age and sex of both the person and the bear; (5) human activity at the time of the attack; and (6) the attack scenario, i.e. the factor(s) that could have triggered the attack.

An Overview of Bear Attacks in the World

Sun Bear

The sun bear, the smallest ursid in the world, is found in South-East Asia, where few ($n = 11$) attacks on humans have been reported. Although the available information is scarce and incomplete (Sethy & Chauhan 2013), attacks seem to be extremely rare and mainly the consequence of sudden encounters (i.e. with the bear being inadvertently surprised at a close distance). Such encounters mainly occur when people venture inside the forest for different purposes (Sethy & Chauhan 2016). For example, in Indonesia most attacks happen to

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Figure 17.1 The sloth bear's aggressively defensive nature may be the result of having coevolved with large predators, such as tigers and leopards, which are known to occasionally prey upon this bear. Actually, sloth bears are strong animals that possess large canines and claws, which make them difficult prey. (Photo by Ayan Sadhu.) (A black and white version of this figure will appear in some formats. For the color version, please refer to the plate section.)

people working in the forest on a daily basis, such as rubber harvesters (55%, $n = 6$), whereas fewer cases occurred to people who work in crop fields and collect non-timber forest products (Windler 2014). In general, encounters with these bears are mainly non-fatal.

Sloth Bear

Sloth bears are known for their aggressive behavior toward humans (Burton 1856; Anderson 1957). Although the total number of people seriously injured or killed by sloth bears during a given year is not known, within one Indian state (Madhya Pradesh, central India), 48 sloth bear-inflicted fatalities and 687 maulings were documented between 1989 and 1994 (Rajpurohit & Krausman 2000). This accounts for an average of six deaths and 115 maulings per year in this Indian state. Because sloth bears occupy 19 Indian states, as well as Nepal, Sri Lanka, and possibly Bhutan, this species might be responsible for more attacks on humans than all other seven species of bears combined.

The sloth bear's motivation to attack seems to be mainly defensive. There has never been a documented predatorial attack (Sharp et al. 2017), although there have been several cases of sloth bears consuming portions of their victims (Bargali et al. 2005; Akhtar 2006). This appears to be the result of opportunistic behavior after the attack, rather than the motivation for the attack. The sloth bear's aggressively defensive nature may be the result of having coevolved with large predators, namely tigers *Panthera tigris* and leopards *Panthera pardus*, which are known to occasionally prey upon sloth bears (Littledale 1889; Fenton 1909; Kurt & Jayasuriya 1968; Laurie & Seidensticker 1977). Sloth bears are not adept climbers and are often in scrub jungle or grasslands, where climbing is not an option. They are not particularly fast runners, either.

However, they are exceptionally strong animals that possess large canines and claws. Although no match for a tiger in an extended encounter, sloth bears can make themselves a particularly difficult prey (Figure 17.1). In addition to their physical attributes, sloth bears make use of intimidation tactics, such as charges coupled with vocalizations and making themselves appear larger with a bipedal stance (Bargali et al. 2005; Ratnayeke et al. 2014; Sharp et al. 2017). This aggressive–defensive nature may serve to deter predators, but impedes conservation efforts whenever they attack humans (Akhtar 2006; Dharaiya et al. 2016).

To better understand this type of human–sloth bear conflict, we compiled information on 1169 attacks that took place in the three countries with extant sloth bear populations: India, Nepal, and Sri Lanka. We also considered the reported results from individual studies conducted throughout the sloth bear's distribution. We found that the spatiotemporal patterns of these attacks varied across studies. Whereas some studies reported a spike in attacks during the monsoon season, others reported more attacks during the dry season (Rajpurohit & Krausman 2000; Bargali et al. 2005; Ratnayeke et al. 2014; Garcia et al. 2016; Dhamorikar et al. 2017; Sharp et al. 2017). These differences may be related to seasonal and daily patterns of human use of forests, or to proximity between bears and people in highly fragmented bear populations. For example, in Bilaspur (India), attacks mainly occur in villages and agricultural fields (Bargali et al. 2005), whereas in other study areas, the majority of attacks occur in forests (e.g. Ratnayeke et al. 2014; Dhamorikar et al. 2017). The high number of attacks during monsoon may be because people start agricultural practices in crop fields, collect mushrooms from the forest, and use forests for livestock grazing at the onset of this season. In monsoon, there is increased vegetation cover as well. Such a combination of different factors and the increased disturbance

in and around sloth bear habitats considerably augment the probability of risky encounters with a sloth bear.

The time of day when attacks occurred also varied a great deal. Although some studies suggested that dawn and dusk were the most dangerous times to be moving through sloth bear country (Bargali et al. 2005; Mardaraj & Dutta 2011; Mardaraj 2015; Debata et al. 2017; Dhamorikar et al. 2017; Sharp et al. 2017), others reported that most attacks occurred during the middle of the day (Ratnayeke et al. 2014; Garcia et al. 2016).

There is little doubt that local factors, including human activity patterns, play a large role in the spatiotemporal patterns of sloth bear attacks. For example, although sloth bears are generally known to be more active at dusk and during the night, in many places several attacks occurred during the day. This may be partly due to resting bears being disturbed, or surprised, rather than the presence of active bears; actually, very few attacks happen during daylight hours in areas that are known to have many natural caves and hollows.

A large portion of attacks (42%) took place when humans were active in the forest (e.g. collecting forest products, walking, etc.). For example, in central India, people collect tendu leaves (*Diospyros melanoxylon*) and mahua flowers and seeds (*Madhuca indica*) for commercial use, as well as sal leaves (*Shorea robusta*), bamboo (*Dendrocalamus strictus*), chironji (*Buchanania lanzan*), and wild mushrooms, which increases the probability of sudden encounters between people and sloth bears. The second highest category (25%) involved persons who were farming or caring for orchards. These types of activities are more often performed by men than by women or children, which likely explains why adult males were found to be involved in the majority of attacks (87%).

Perhaps surprisingly, the third highest number of attacks (15%) took place when humans were defecating in the forest. This tends to occur in areas which are often frequented for this purpose. The reason for this type of attack is unclear. It is possible that fecal odours attract sloth bears to areas often used for defecation. However, this is purely speculative at this point, although it is interesting to note that the smell of human feces is known to also attract both brown and American black bears (T. Smith, unpublished data).

Sudden encounters triggering defensive–aggressive attacks accounted for 47% of the attacks. Often the victim was unaware of the sloth bear's presence until they saw the bear charging from just meters away (Figure 17.2). Like most mammals, sloth bears are protective of their young and, of the 1169 attacks compiled for this chapter, 22% involved females with cubs, although several studies reported this number to be higher (Ratnayeke et al. 2014; Sharp et al. 2017).

Most studies on sloth bear attacks report that human group size plays a role in the likelihood of attack (Ratnayeke et al. 2014; Sharp et al. 2017). We found that nearly half of all attacks involved a single person (46%). However, reported group size can be misleading, because if people are spread out, the bear may perceive each individual as a single person, rather than as



Figure 17.2 The main scenario of sloth bear attacks on humans is sudden encounters in dense forests, where the victim is often unaware of the bear's presence. (Photo by Luxshmanan Nadaraja.)

part of a group. Ratnayeke et al. (2014) found that a human companion <50 m away significantly reduced the likelihood of severe injury during a sloth bear attack. Human groups are likely to be noisier, thus less likely to surprise a bear, and more intimidating to an attacking bear than a solitary person. Additionally, in some cases the person attacked by a sloth bear has been saved by other nearby people or even by animals accompanying the victims (Bargali et al. 2005; Dhamorikar et al. 2017; Silwal et al. 2017), although dogs may sometimes precipitate an attack. Indeed, Ratnayeke et al. (2014) reported three attacks that resulted from dogs running back to their owners with a bear in pursuit, putting the human directly in the path of an angry bear.

Of the 1169 sloth bear attacks we reviewed, only 5% ($n = 58$) resulted in the death of the victim. Based on other studies (Sharp et al. 2017), moderate to severe injuries make up another 35–50% of the attacks.

Asiatic Black Bear

Although not scientifically documented, the Asiatic black bear seems to be more nervous than its American relative, the American black bear. This might be due to the relatively small body size compared to humans or to long-term persecution by humans (Japan Bear Network 2006; Yamazaki 2010). Because Asiatic black bears are generally shy and nervous, most of their attacks on humans are defensive, especially when a female bear is with cubs or in the event of sudden or unexpected encounters (Rasool et al. 2010; Japan Bear Network 2011).

Our search resulted in a total of 747 attacks by Asiatic black bears in Pakistan, India (Kashmir, northern India), Bhutan, Nepal, Russia (Far East Region), and Japan (Honshu Island, the largest and most populous island of Japan). Although we do not know whether bears hibernate throughout these areas, most attacks occurred between May and November, with the highest frequency of attacks occurring in October (18%).

Ninety-five percent of the attacks occurred between April and November and 5% from December to March. During late autumn and early winter, when bears enter their hyperphagic period, they predominantly rely on acorns (Kozakai et al. 2011) and, when the autumn acorn production is low, bears become bolder and search for alternative, high-energy food resources (Kozakai et al. 2011; Ali et al. 2018), resulting in drastically increased human–bear conflicts, including bear attacks.

Most attacks occurred during daylight (94%), compared to twilight (4%) and night (2%). Even though Asiatic black bears are diurnal and their activity peaks are during dawn and dusk (Hwang & Garshelis 2007; Yamazaki et al. 2008), they can modify their behavior to become more nocturnal when they approach human settlements (Arimoto et al. 2014).

Most people involved in attacks were males (78%). Attacks mainly occurred while people were farming or participating in various activities in the forest (45% and 32%, respectively), and it is possible that more males are generally involved in these activities than females. The age of victims was biased towards adults (>13 years old, 94%), which is likely explained by the same phenomena as the sex bias. Most of the attacks recorded were the result of sudden encounters (86%), with bears reacting aggressively when surprised at close distances. Notably, we found that at least 30% of such encounters occurred while bears were feeding on crops or other products in people's fields or orchards. Such a scenario has been found to be the main attack circumstance in several studies, with people encountering bears at close range and consequently being attacked when visiting or working in their crop fields or orchards (Nabi et al. 2009a; Tak et al. 2009; Rasool et al. 2010; Charoo et al. 2011). Other reported scenarios involve people entering dense forest to collect wood or other forest products, or to graze livestock (Tak et al. 2009; Lal Moten et al. 2017; Ali et al. 2018).

The number of bear attacks has been increasing recently in Nepal (Acharya et al. 2016), India (Kashmir; Nabi et al. 2009b), and Japan (Yamazaki 2010). This is mostly due to human population expansion, deforestation, and destruction and fragmentation of bear habitat in most Asian countries (Japan Bear Network 2006). In contrast, the reason for increasing bear attacks in Japan is quite different, because the population and range of bears have been expanding in recent decades, due to habitat recovery as a result of aging human population and depopulation (Yamazaki 2004; Yamazaki & Sato 2014). From statistics supplied by the Ministry of Environment in Japan, 851 people were attacked (including 13 deaths) by bears in the last 10 years (2008–2017). Although the frequency of attacks by Asiatic black bears is relatively high, these attacks rarely result in fatalities (8%). Similar or lower fatality rates are reported in Nepal (Acharya et al. 2016), India–Kashmir (Nabi et al. 2009b; Rasool et al. 2010; Shah et al. 2010), and Japan (Akiyama et al. 2017). Although fatalities are rare, injuries are frequently serious, as bears often stand upright and first attack the person's neck and face using their claws, causing damage

such as bone fractures and deep tissue lacerations (Nabi et al. 2009b; Rasool et al. 2010; Oshima et al. 2018). As a consequence, many victims must undergo multiple and complex facial reconstructive surgeries (Rasool et al. 2010; Shah et al. 2010).

In the northern part of Honshu Island, Akita Prefecture, Japan (Yamazaki 2017; Oshima et al. 2018), four local residents who were gathering bamboo shoots were killed and partially eaten by bears in 2016, and another local resident was attacked and partially eaten by a bear(s) in 2018. As a result, local attitudes toward bears have drastically changed within this prefecture and have become more negative, resulting in a total of 1676 bears being killed as nuisance animals between 2016 and 2018. These attacks have had a bad influence even in other prefectures, and bear management is facing serious difficulties in many areas.

American Black Bear

Outnumbering the other two species of North American bears 10-fold, the American black bear is the most ubiquitous ursid on the continent (Herrero 2018). Not surprisingly, black bears account for the majority of human–bear incidents in North America (Penteriani et al. 2016). Indeed, our search resulted in 373 attacks reported between 1980 and 2016, and only 11% were fatal. In a recent study of human–bear conflict in Alaska, Smith and Herrero (2018) reported that black bears, which outnumber brown bears three to one in the state, were responsible for only 14% (89 of 638) of bear attacks reported from 1880 to 2016. This suggests a tolerance for humans not shared by brown bears. Herrero (1972) suggested that this reluctance to engage with people is the result of their unique evolutionary past. Black bears evolved in the densely forested regions of North America and could often resolve conflict by either climbing a tree or disappearing into the dense understory (Herrero 1972). Therefore, when suddenly confronted by people, they frequently flee. Indeed, Smith and Herrero (2018) found in Alaska that brown bears accounted for nearly six times more attacks than black bears (508 vs. 89), resulting in 47 brown bear-inflicted fatalities compared to just five due to black bears (a 9.4-times higher rate for brown bears).

Nonetheless, on rare occasions, when black bears attacked and killed people, 90% of them were deemed predatory (Herrero et al. 2011). From 1900 to 2009, Herrero et al. (2011) documented 63 fatal black bear attacks in the United States and Canada. They also found that black bear-inflicted fatalities were highly correlated with human population growth in those countries, suggesting that the more people enter black bear habitat, the more likely it is that a conflict will arise. Although the vast majority of black bears clearly avoid conflict with humans, a few bears apparently perceive people as prey and attempt to take them.

Herrero and Higgins (2003) identified predatory black bears by a series of behaviors: searching, following and testing,

attacking (capturing), killing, sometimes dragging a person, sometimes burying, and often feeding upon a person. By analyzing patterns of predatory attacks by all large carnivore species in North America, Penteriani et al. (2017) found that the black bear was the third species most frequently involved in this kind of encounter (16%), after cougars and coyotes, and, as expected, the targets of predatory attacks were the most vulnerable individuals, namely children and lone people.

Black bears are powerful predators quite capable of inflicting severe injury and death on humans. Herrero et al. (2011) speculated that black bears likely do not prey on people more often than they do because bears with those genes have been consistently culled from the gene pool. Importantly, fatal attacks by black bears are fundamentally different than those of brown bears because browns are rarely predatory, whereas black bear-inflicted fatalities are almost always the result of predation. Unlike brown bears, black bears have been often reported to cause conflicts and, more rarely, injure people in urban areas across North America (Bombieri et al. 2018b). In such environments, risky encounters with this species are mainly due to the presence of dogs or anthropogenic food (e.g. a bear is surprised by a person while feeding on pet food or trash in the yard and reacts aggressively). Probably due to the forest-obligate nature of the species, attacks in urban areas are more likely to occur where the vegetation cover is more abundant and less fragmented and far from buildings and roads. Half of such encounters have been found to occur at night, especially in areas where the artificial illumination is scarce (Bombieri et al. 2018b).

Brown Bear

There are always conflicts wherever humans and brown bears commingle. Several studies have shown that increases in the number of brown bear conflicts are roughly proportional to human population growth in North America (Herrero et al. 2011; Sharp et al. 2017; Smith & Herrero 2018). Although long absent from many localities, people still harbor an inordinate fear of brown bears; a fear that is deeply rooted in our past history, as explained by Wilson (1984):

The brain evolved into its present form over a period of about 2 million years, from the time of *Homo habilis* to the late stone age of *Homo sapiens*, during which people existed in hunter-gatherer bands in intimate contact with the natural environment. The smell of water, the hum of a bee, the directional bend of the plant stalk mattered. The naturalist's trance was adaptive: the glimpse of one small animal hidden in the grass could make the difference between eating and going hungry in the evening. And a sweet sense of horror, the shivery fascination with monsters and creeping forms that so delights us today even in the sterile hearts of our cities, could see you through to the next morning. Organisms are the natural stuff of metaphor and ritual. Although the evidence is far from all in, the brain appears to have kept its old capacities, its channelled quickness. We stay alert and alive in the vanished forests of the world.

This innate fear is kept alive by the media, which often focuses an inordinate amount of attention on attacks by brown bears, thus fueling fear and undermining conservation efforts (Penteriani et al. 2016; Bombieri et al. 2018a). Human–brown bear conflicts occur throughout their range, and though few in number, have profound impacts on both the people and bears involved (Conover 2008; Penteriani et al. 2016). A study by Bombieri et al. (2019) investigated circumstances of brown bear attacks that occurred worldwide between 2000 and 2015 and highlighted common characteristics, as well as differences in attack patterns between regions of the world with different sociocultural backgrounds and histories of coexistence with this species. According to this study, people involved in attacks are almost exclusively adults (99%) and human fatalities are rare (15%). Globally, attacks are mainly the result of an encounter with a female bear with cubs (47%; Figure 17.3A), followed by sudden encounters with other bear classes (20%), dog presence (17%; Figure 17.3B), bear attacking after being shot or trapped (10%), and predatory attacks (5%). At the moment of the attack, half of the people were engaged in leisure activities (e.g. hiking, picking berries or mushrooms, camping, fishing), whereas 28% of the attacked people were working outside, i.e. farming, guarding livestock, or logging, or doing wildlife-related fieldwork, and 22% were hunting. Although patterns are similar in many regions across the wide distribution range of brown bears, local differences in attack scenarios also exist. For example, in Romania, where traditional semi-subsistence agriculture and livestock husbandry are common, half of the people involved in attacks were shepherds, cattle herders, and farmers (Bombieri et al. 2019), whereas most (75%) of the attacks that occurred in Scandinavia between 1977 and 2016 involved hunters (Støen et al. 2018). Hunters are often involved in bear attacks, because they are trying not to make noise while hunting and may consequently surprise bears, thus triggering an attack. Other factors connected to hunting may also explain the higher risk of an attack. In Scandinavia most (73%) of the hunter casualties had shot at the bear at short range (average 8 ± 11 m) before being injured and hunting dogs harassed the bears in 77% of the incidents involving hunters (Støen et al. 2018).

A recent study by Smith and Herrero (2018) chronicled 135 years of human–bear conflict involving nearly 700 incidents in Alaska, of which 78% involved brown bears. The findings of this study, although regional, offer useful insights regarding attacks, because brown bears react similarly to human confrontation regardless of locality, even though regional differences in bear responses to humans have been documented.

For example, Smith et al. (2008) reported that brown bears in Alaska respond somewhat differently toward humans in coastal areas (areas of abundant resources that support high-density bear populations, which are more tolerant of humans at very close ranges) compared to brown bears in interior areas (areas relatively scarce in resources supporting low-density populations that are more intolerant of humans). Additionally,



Figure 17.3 Two of the main brown bear attack scenarios: (A) defensive reaction of a female with cubs; and (B) unleashed dogs harassing bears. (Photos by Ivan Seryodkin.)

it has been posited that heavily hunted brown bear populations become more wary of people, although Swenson (1999) failed to find definitive evidence of that.

In general, Smith and Herrero (2018) found that increases in the number of brown bear attacks in Alaska over a 135-year period were strongly correlated with the growth of Alaska’s human population. Similarly, when brown bear attack rates were regressed against a simple index created by combining both brown bear and human densities within a given region of the world, they were found to be positively correlated (data adapted from Bombieri et al. 2019).

When bear encounters occurred, bears disproportionately attacked single persons, so grouping together decreased the likelihood of an attack. A similar finding was reported by Penteriani et al. (2016) and Garrote et al. (2017). Group size may yield this effect because larger groups are noisier and alert bears to approaching humans (Herrero et al. 2011). Of the persons involved in bear conflicts in Alaska in this study

(Smith & Herrero 2018; $n = 1550$), those without a deterrent (i.e. firearms, bear spray, etc.) resorted to desperate and ineffective evasive actions, such as running, tree-climbing, rock-throwing, and attempting to fight the animal bare-handed, strategies that rarely worked. Importantly, having a deterrent did not guarantee that the person would avoid injury; but those with deterrents suffered less injury, and less-severe injuries, than those without. Of particular note, those persons with bear spray largely escaped injury (98%), whereas persons bearing firearms suffered more (24% were injured; Smith et al. 2012).

Finally, Smith and Herrero (2018) found that attacking bears focused on the victim’s head and neck regions, a finding which suggests that Herrero (2018) was justified in promoting a defensive posture of lying face-down, hands laced over the back of the neck and legs spread to provide the ability to thwart a bear’s effort to flip the body over and face up. Coming to the aid of an attack victim almost always terminated the attack, perhaps because the bear felt outnumbered and left. Although domestic dogs could be helpful in protecting persons from an attack (47.5%), some abandoned their masters (40%). A few dogs (12.5%) reportedly initiated the attack.

Polar Bear

Human–polar bear conflicts have existed for as long as both species have shared the Arctic. Without a written language, these conflicts went unrecorded by indigenous people, but undoubtedly occurred with some regularity. The earliest written accounts of human–polar bear conflict are sporadic and were recorded by European mariners who kept journals. Among the earliest of these is an account of Dutch mariner William Barents (1594), who attempted to capture a polar bear to bring back alive to Holland (Wikipedia 2019). Unfortunately, the bear broke loose aboard ship, rampaged through the vessel, and was killed in the process. Additionally, Barents wrote a year later that two men in his expedition were attacked and killed by a polar bear, the earliest polar bear-inflicted fatalities we know of on record. More recently, Charlie Brower of Barrow (Alaska) witnessed a polar bear casually crush the skull and ribs of a Native guide in 1883 (Brower 1942). Such graphic accounts have unquestionably fuelled the widely held belief that it is fundamental to a polar bear’s nature to “stalk and kill humans” (Ramachandran 2009). Even though brutal accounts of polar bears ravaging humans dot the pages of history books, one must ask if they truly deserve the name “stalker and killer of humans.” Human–polar bear attack research does not support that claim.

In recent years, a number of studies have documented the nature of human–polar bear conflicts (Fleck & Herrero 1988; Clark 2003; Wilder et al. 2017). Both Clark (2003) and Fleck and Herrero (1988) reported that most human–polar bear interactions do not result in injury, and when persons were injured, rates of interactions resulting in injury were

low (2% and 5%, respectively). Specifically, Clark (2003) reported that only one bear-inflicted injury occurred in 53 polar bear–human interactions. Fleck and Herrero (1988) documented 373 aggressive polar bear–human interactions, of which only 10 bear-inflicted injuries occurred. Because Wilder et al. (2017), reported only on polar bear attacks, their data are not comparable to the previous studies that included non-injurious interactions. However, over a 144-year period, Wilder et al. (2017) documented only 73 attacks on humans by polar bears across their entire range, and in those attacks 20 persons were killed and another 63 injured. By contrast, Smith and Herrero (2018) reported nearly the same number of attacks for brown bears in Alaska in a single decade (2000–2009). The record is clear that polar bears injure and kill far fewer humans than do black and grizzly bears (Fleck & Herrero 1988). Although some may point out that the interaction rates between polar bears and humans are far lower than those of black bears and grizzlies, injuries are low and deaths extremely rare where polar bears and people commingle considerably (e.g. Churchill, Manitoba; Kaktovik, Alaska). In all of these human–polar bear interactions, predation was rare, but when people were killed, predation was considered the primary motivation (Wilder et al. 2017).

The “Take in the Bear Home” Message: How to Avoid and Survive Bear Attacks and Specific Measures of Risk Reduction

Sloth Bear

Information on sloth bear attacks suggests that being in a group and making noise while moving through sloth bear habitats helps reduce the likelihood of startling a bear at close quarters, giving it the opportunity to leave the area without incident. Bear spray and guns are not available for protection to most who live in sloth bear country and many attacks occur too quickly for weapons to be used effectively. However, villagers carrying a heavy club or walking stick have been able to drive off an attacking bear, and this might prove to be especially effective when more than one person acts in concert (Ratnayeke et al. 2014; Sharp et al. 2017).

If a sloth bear is observed, but is not aware of the observer, people should slowly back away, giving the bear as much space as possible. Running has been reported to trigger a chase response, and several runners have been pursued and killed by sloth bears (Sharp & Sonone 2011; Ratnayeke et al. 2014; Sharp et al. 2017). Yelling or throwing stones at a non-aggressive sloth bear may also elicit an attack.

Although some have reported that the sloth bear retreated when fought, Sharp et al. (2017) reported that those who fought were more likely to be killed than people that played dead. The safest response to an attack might highly depend on factors such as the bear motivation to attack and the human

characteristics as well as group size. A person that is attacked may decrease the risk of injury or death by using the protective position recommended by Herrero (2018) for grizzly bear attacks: lying face down on the ground with hands locked behind the neck and arms protecting the face. The effectiveness of this defensive position for sloth bear attacks is yet untested; however, most sloth bear attacks are defensive, cause injuries to the face and head, and limited data suggest that the attack does not persist when the bear perceives that the threat has faded.

Temporal patterns of sloth bear attacks across different geographic areas suggest that peaks in specific types of human activities increase the potential for human–sloth bear encounters and attacks. These activities may vary by location and managers should work with local people to seek solutions. For example, at locations where bears frequent village compounds and agricultural fields, villagers could be encouraged and financially supported to construct toilets and to use extreme caution moving around when bears are active (Jangid & Sharma 2018). Similarly, avoiding the collection of “non-timber forest products” during twilight hours may reduce the risk of encountering active sloth bears. Moving in groups and advertising one’s presence via sound and loud conversation will give resting bears an opportunity to leave the area. In areas where bears reside within or on the periphery of human settlements, cultivating crops (e.g. maize, ground nuts) that attract bears will increase the likelihood of attacks, let alone crop losses. Training programmes aimed at sustainable livelihoods, including support for alternative forms of agriculture and income to reduce the dependency of local communities on forest resources could help to keep sloth bears and people well-separated. Proper garbage/waste management practices should be promoted in those areas where sloth bears are attracted and approach garbage sites to feed on remnants of fruits and edible materials (A. Jangid, unpublished data). In addition, provisioning of edible materials in remote temples should be stopped, so the encounters can be reduced near temple sites. Indeed, a few cases have been reported of bears breaking in and raiding houses and small temples located inside forests to feed on edible products such as oils left by pilgrims as offerings (A. Jangid, unpublished data; Singh et al. 2017; Jangid & Sharma 2018), alarming the villagers. Finally, for bears that have little alternative but to survive in forest fragments surrounded by agriculture and human settlements, guidelines and policies for safely trapping and relocating them may be the most feasible option (Figure 17.4).

Asiatic Black Bear

There are no easy solutions to reduce Asiatic black bear attacks on humans. However, public education about bears (i.e. bear habitat, behavior, and ecology) to local residents and people engaging in various activities in the forest can be an effective approach (Japan Bear Network 2006; Jamtsho &

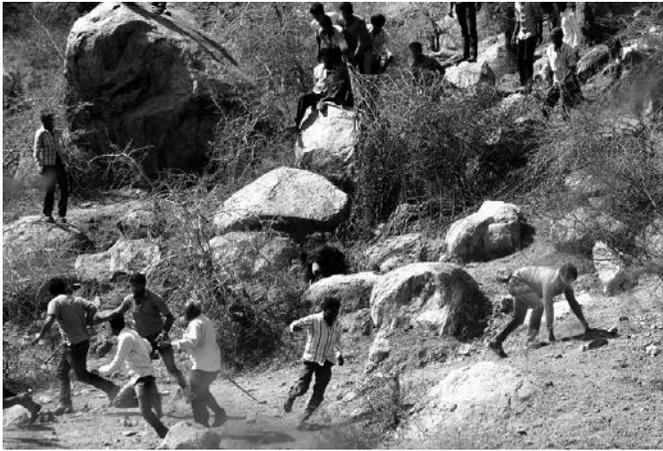


Figure 17.4 Trapping and relocating conflictual sloth bears might represent an alternative to retaliatory killing. (Photo by Ashish Jangid.)

Wangchuk 2016). Because attacks often occur on farmers working on crop fields or orchards, suggesting that bears are attracted by agricultural products, preventive measures aimed at protecting such areas might prove effective to avoid both crop raiding and potentially dangerous encounters between farmers and bears (Jamtsho & Wangchuk 2016). Moreover, people should be cautioned about the possibility of encountering bears when working in their crop fields or moving in the forest and should be provided information on how to avoid being attacked. Moving in a group and making noise while moving in areas with poor visibility might help the bear notice human presence and leave the area to avoid the encounter (Rasool et al. 2010). Given the evident defensive strategy of attacking the head and face region commonly adopted by Asiatic black bears, if a bear reacts aggressively when encountered, people should not fight back, but protect these sensitive regions and adopt a passive position. It has been shown, indeed, that the attack terminated spontaneously in most of the cases, with the bear leaving immediately once the victim was overpowered (Rasool et al. 2010; Shah et al. 2010). Also, increasing the distribution/availability of bear avoidance equipment, such as pepper spray, at affordable prices could also be effective. Once a bear attack has occurred, comprehensive on-site verification and sharing of the obtained information among related organizations is also very important to prevent similar types of incidents in the future.

American Black Bear

Smith and Herrero (2018) and Herrero and Higgins (2003) identified a number of insights regarding safety in black bear country. These findings fall into four broad categories of bear safety messaging: (1) general information; (2) how to avoid bear encounters; (3) how to defuse encounters; and (4) how to survive attacks. First, food and garbage should be secured to avoid attracting bears. People should move in bear areas in

groups of more than two and try to group together if a bear is encountered. Carrying bear spray is highly recommended. Additional specific precautions should be taken in urban areas and their proximities (Bombieri et al. 2018a). In such environments, increased attention to dogs and improved management of attractants (i.e. avoid leaving garbage, pet food, and bird feeders outside houses) would likely reduce the probability of risky encounters with this species. Moreover, to reduce the occurrence of predatory attacks, particular attention should be paid with children, who need to be constantly and strictly supervised by adults (Garrote et al. 2017; Penteriani et al. 2017). Finally, in case of an attack, being able to recognize the motivation behind it may be crucial in determining the attack outcome. That is, in the case of a predatory attack, one should try to aggressively deter the bear and fight back in any possible way. Instead, if the attack is defensive, one should be passive and adopt a defensive posture by lying face-down and protecting the neck with the hands.

Brown Bear

Based on findings by Smith and Herrero (2018), actions that avoided brown bear encounters include being wary during their most active time of day (midday through evening), avoiding areas with poor visibility when possible, making noise to alert bears to one's presence, and hiking in a party (≥ 2 people). These safety measures have also been recommended for forest users in Scandinavia (Støen et al. 2018), where bears reside in rugged terrain (Nellemann et al. 2007), rest in dense vegetation during daytime to avoid people (Ordiz et al. 2011), and generally flee when encountered (Moen et al. 2012). Of particular note, brown bear attacks, including fatalities, have been documented in every month of the year, underscoring the fact that one must employ bear avoidance practices year-round. Similar to advice highlighted for black bear encounters, carrying bear spray and grouping together when encountering a bear is recommended to avoid being attacked. In Scandinavia, awareness and education efforts, especially among hunters, have also been highlighted to ensure human safety (Støen et al. 2018). Because brown bear attacks are mostly defensive, if attacked one must be passive and adopt a defensive posture. Importantly, Smith and Herrero (2018) reported that, when rescuers came to the aid of the victims, the mauling ended 91% of the time, highlighting the importance of coming to the aid of the victim. Although dogs might help terminate an attack, one should make sure they obey commands and, preferably, keep them on a leash to avoid them disturbing bears and therefore triggering an aggressive reaction toward the dog and its owner.

Polar Bear

Wilder et al. (2017) cautioned that, as sea ice continues to shrink, human–polar bear conflict can be expected to rise.

Importantly, Fleck and Herrero (1988) observed that the outcome of human–polar bear conflict was most often a dead bear and much more rarely an injured or dead human. Therefore, improved conflict investigation is needed to collect accurate and relevant data and communicate accurate bear safety messages and mitigation strategies to the public. With better information, people can take proactive measures in polar bear habitat to ensure their safety and prevent conflicts with polar bears.

To conclude, although rare, bear attacks on humans do occur within the whole range of bear species and undermine bear conservation efforts (Røskaft et al. 2007). Different bear species showed differing attack patterns, and although some bear species, such as the Andean bear, the sun bear, and the giant panda have never or rarely been reported to be involved in such incidents, the other five species of bears may locally represent a more serious threat to human safety. Therefore, it is of the utmost importance for bear conservation worldwide to reduce such conflicts by developing and implementing effective strategies based on both species-specific characteristics and the local socioeconomic context. In developed countries, where most attacks occur on people involved in recreational activities in bear areas, conflicts can be decreased through education and outreach (i.e. providing accurate bear safety messaging to the public). For instance, recent efforts in

Yosemite National Park have demonstrated that with effective education, outreach, and appropriate penalties for the uncompliant, bear conflicts can be dramatically decreased (down by 99% since 1998), benefitting both people and bears (National Park Service 2019). A different approach should be employed in developing countries, where people involved in attacks are mostly local people who must enter bear areas for their daily work- and subsistence-related activities. Here, education on how to avoid bear encounters and attacks might not be sufficient alone and must be combined with improved facilities and financial support for local communities living in bear areas.

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References

- Acharya, K. P., Paudel, P. K., Neupane, P. R. & Köhl, M. (2016). Human–wildlife conflicts in Nepal: patterns of human fatalities and injuries caused by large mammals. *PLoS ONE* 11: 1–18.
- Akhtar, N. (2006). Human–sloth bear conflict: a threat to sloth bear conservation. *International Bear News* 15: 15–17.
- Akiyama, G., Kuwahara, H., Asahi, R., Tosa, R. & Yokota, H. (2017). Prompt procedures have a great impact on the consequences of Asiatic black bear mauling. *Journal of Nippon Medical School* 84: 294–300.
- Ali, A., Waseem, M., Teng, M., et al. (2018). Human–Asiatic black bear (*Ursus thibetanus*) interactions in the Kaghan Valley, Pakistan. *Ethology Ecology and Evolution* 30: 399–415.
- Anderson, K. (1957). *Man-eaters and jungle killers*. London: George Allen and Unwin Ltd.
- Arimoto, I., Okamura, H., Koike, S., Yamazaki, K. & Kaji, K. (2014). Behavior and habitat of Asiatic black bear (*Ursus thibetanus*) inhabiting near settlements. *Honyuruikagaku* 54: 19–31.
- Bargali, H. S., Akhtar, N. & Chauhan, N. P. S. (2005). Characteristics of sloth bear attacks and human casualties in North Bilaspur Forest Division, Chhattisgarh, India. *Ursus* 16: 263–267.
- Bombieri, G., Delgado, M. del M., Russo, L. F., et al. (2018a). Patterns of wild carnivore attacks on humans in urban areas. *Scientific Reports* 8: 17728.
- Bombieri, G., Nanni, V., Delgado, M. del M., et al. (2018b). Content analysis of media reports on predator attacks on humans: toward an understanding of human risk perception and predator acceptance. *BioScience* 68: 577–584.
- Bombieri, G., Naves, J., Penteriani, V., et al. (2019). Brown bear attacks on humans: a worldwide perspective. *Scientific Reports* 9: 8573. <https://doi.org/10.1038/s41598-019-44341-w>
- Brower, C. (1942). *Fifty years below zero: A lifetime of adventure in the Far North*. New York, NY: Dodd, Mead and Company.
- Burton, R. G. (1856). *A book of man eaters* (first edition 1931). Delhi: Mittal Publications.
- Chapron, G., Kaczensky, P., Linnell, J.D.C., et al. (2014). Recovery of large carnivores in Europe’s modern human-dominated landscapes. *Science* 346: 1517–1519.
- Charoo, S. A., Sharma, L. K. & Sathyakumar, S. (2011). Asiatic black bear–human interactions around Dachigam National Park, Kashmir, India. *Ursus* 22: 106–113.
- Clark, D. (2003). Polar bear–human interactions in Canadian national parks, 1986–2000. *Ursus* 14: 65–71.
- Conover, M.R. (2008). Why are so many people attacked by predators? *Human–Wildlife Interactions* 2: 139–140.
- Debata, S., Swain, K. K., Sahu, H. K. & Palei, H. S. (2017). Human–sloth bear conflict in a human-dominated landscape of northern Odisha, India. *Ursus* 27: 90–98.
- Dhamorikar, A. H., Mehta, P., Bargali, H. & Gore, K. (2017). Characteristics of human–sloth bear (*Melursus ursinus*) encounters and the resulting human casualties in the Kanha–Pench corridor, Madhya Pradesh, India. *PLoS ONE* 12: 1–18.
- Dharaiya, N., Bargali, H. S. & Sharp, T. (2016). *Melursus ursinus*. The IUCN Red List of Threatened Species 2016: e.T13143A45033815 (WWW document). <http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T13143A45033815.en>
- Fenton, L. L. (1909). Tiger attacking a bear. *Bombay Natural History Society* 979.

- Fleck, S. & Herrero, S. (1988). Polar bear–human conflicts. Contract report for Parks Canada and GNWT, contract 502/85/23.
- Garcia, K. C., Joshi, H. M. & Dharaiya, N. (2016). Assessment of human–sloth bear conflicts in North Gujarat, India. *Ursus* 27: 5–10.
- Garrote, P. J., Delgado, M. del M., López-Bao, J. V., et al. (2017). Individual attributes and party affect large carnivore attacks on humans. *European Journal of Wildlife Research* 63: 80.
- Herrero, S. (1972). Aspects of evolution and adaptation in American black bears (*Ursus americanus* Pallas) and brown and grizzly bears (*U. arctos* Linné.) of North America. *Bears: Their Biology and Management* 2: 221.
- Herrero, S. (2018). *Bear attacks: Their causes and avoidance*, 3rd edition. New York, NY: Lyons & Burford.
- Herrero, S. & Higgins, A. (2003). Human injuries inflicted by bears in Alberta: 1960–98. *Ursus (Knoxville)* 14: 44–54.
- Herrero, S., Higgins, A., Cardoza, J. E., Hajduk, L. I. & Smith, T. S. (2011). Fatal attacks by American black bear on people: 1900–2009. *Journal of Wildlife Management* 75: 596–603.
- Hwang, M. H. & Garshelis, D.L. (2007). Activity patterns of Asiatic black bears (*Ursus thibetanus*) in the Central Mountains of Taiwan. *Journal of Zoology* 271: 203–209.
- Jamtsho, Y. & Wangchuk, S. (2016). Assessing patterns of human–Asiatic black bear interaction in and around Wangchuck Centennial National Park, Bhutan. *Global Ecology and Conservation* 8: 183–189.
- Jangid, K. A. & Sharma, K. R. (2018). How locals characterize the causes of sloth bear attacks in Jawai, Rajasthan. *International Bear News* 27: 11–12.
- Japan Bear Network. (2006). *Understanding Asian bears to secure their future*. Ibaraki: Japan Bear Network.
- Japan Bear Network. (2011). *Report on statistics of the bear caused human injuries* (in Japanese). Ibaraki: Japan Bear Network.
- Kozakai, C., Yamazaki, K., Nemoto, Y., et al. (2011). Effect of mast production on home range use of Japanese black bears. *Journal of Wildlife Management* 75: 867–875.
- Kurt, F. & Jayasuriya, A. (1968). Notes on a dead bear. *Loris* 11: 182–183.
- Lal Moten, T., Bhat, T. A., Gulzar, A., Mir, A. & Mir, F. (2017). Causalities of human wildlife conflict in Kashmir valley, India; a neglected form of trauma: our 10 year study. *International Journal of Research in Medical Sciences* 55: 1898–1902.
- Laurie, A. & Seidensticker, J. (1977). Behavioural ecology of the sloth bear (*Melursus ursinus*). *Journal of Zoology* 182: 187–204.
- Littledale, H. (1889). Bears being eaten by tigers. *Journal of Bombay Natural History Society* 4: 316.
- Mardaraj, P. C. (2015). *Identifying key issues for the conservation of sloth bear (Melursus ursinus) in Rajmilgiri, Odisha, Eastern India*. The Rufford Foundation, United Kingdom.
- Mardaraj, P. & Dutta, S.K. (2011). *Human–sloth bear conflict in Balasore Forest Division, Eastern India*. Saarbrücken, Germany: LAP Lambert Academic Publishing GmbH & Co. KG.
- Moen, G. K., Støen, O. G., Sahlén, V. & Swenson, J. E. (2012). Behaviour of solitary adult Scandinavian brown bears (*Ursus arctos*) when approached by humans on foot. *PLoS ONE* 7: e31699.
- Nabi, D. G., Tak, S. R., Kangoo, K. A. & Halwai, M. A. (2009a). Comparison of injury pattern in victims of bear (*Ursus thibetanus*) and leopard (*Panthera pardus*) attacks. A study from a tertiary care center in Kashmir. *European Journal of Trauma and Emergency Surgery* 35: 153–158.
- Nabi, D. G., Tak, S. R., Kangoo, K. A. & Halwai, M. A. (2009b). Increasing incidence of injuries and fatalities inflicted by wild animals in Kashmir. *Injury* 40: 87–89.
- National Park Service. (2019). Bear facts (WWW document). Available from www.nps.gov/yose/planyourvisit/bearfacts.htm
- Nellemann, C., Støen, O. G., Kindberg, J., et al. (2007). Terrain use by an expanding brown bear population in relation to age, recreational resorts and human settlements. *Biological Conservation* 138: 157–165.
- Ordiz, A., Støen, O. G., Delibes, M. & Swenson, J. E. (2011). Predators or prey? Spatio-temporal discrimination of human-derived risk by brown bears. *Oecologia* 166: 59–67.
- Oshima, T., Ohtani, M. & Mimasaka, S. (2018). Injury patterns of fatal bear attacks in Japan: a description of seven cases. *Forensic Science International* 286: e14–e19.
- Penteriani, V., Delgado, M. del M., Pinchera, F., et al. (2016). Human behaviour can trigger large carnivore attacks in developed countries. *Scientific Reports* 6: 20552.
- Penteriani, V., Bombieri, G., Fedriani, J. M., et al. (2017). Humans as prey: coping with large carnivore attacks using a predator–prey interaction perspective. *Human–Wildlife Interactions* 11: 192–207.
- Rajpurohit, K. S. & Krausman, P. R. (2000). Human–sloth bear conflicts in Madhya Pradesh, India. *Wildlife Society Bulletin* 28: 393–399.
- Ramachandran, A. (2009, November 11). Frozen with fear: stranded teen v polar bears. *The Sydney Morning Herald* (WWW document). Available from www.smh.com.au/world/frozen-with-fear-stranded-teen-v-polar-bears-20091111-i9fs.html
- Rasool, A., Wani, A. H., Darzi, M. A., et al. (2010). Incidence and pattern of bear maul injuries in Kashmir. *Injury* 41: 116–119.
- Ratnayeke, S., Van Manen, F. T., Pieris, R. & Pragash, V. S. J. (2014). Challenges of large carnivore conservation: sloth bear attacks in Sri Lanka. *Human Ecology* 42: 467–479.
- Røskoft, E., Händel, B., Bjerke, T. & Kaltenborn, B. P. (2007). Human attitudes towards large carnivores in Norway. *Wildlife Biology* 13: 172–185.
- Sethy, J. & Chauhan, N.S. (2013). Human–sun bears conflict in Mizoram, North East India: impact and conservation management. *International Journal of Conservation Science* 4: 317–328.
- Sethy, J. & Chauhan, N. S. (2016). Status and distribution of Malayan sun bear in Nandapha Tiger Reserve, Arunachal Pradesh, India. *International Journal of Conservation Science* 7: 533–552.
- Shah, A., Mir, B., Ahmad, I., et al. (2010). Pattern of bear maul maxillofacial injuries in Kashmir. *National Journal of Maxillofacial Surgery* 1: 96.
- Sharp, T. & Sonone, S. D. (2011). Sloth bear attacks: causes and consequences. *International Bear Newsletter* 20: 14–17.
- Sharp, T. R., Swaminathan, S., Arun, A. S., et al. (2017). Sloth bear attack behavior

- and a behavioral approach to safety. Final report to International Association for Bear Research and Management.
- Silwal, T., Kolejka, J., Bhatta, B. P., et al. (2017). When, where and whom: assessing wildlife attacks on people in Chitwan National Park, Nepal. *Oryx* 51: 370–377.
- Singh, N., Sonone, S., Rot, J. & Dharaiya, N. A. (2017). An unusual attractant spurs sloth bear break-ins in Maharashtra, India 26: 20–21.
- Smith, T. S. & Herrero, S. (2018). Human–bear conflict in Alaska: 1880–2015. *Wildlife Society Bulletin* 42: 254–263.
- Smith, T. S., Herrero, S., Debruyn, T. D. & Wilder, J. M. (2008). Efficacy of bear deterrent spray in Alaska. *Journal of Wildlife Management* 72: 640–645.
- Smith, T. S., Herrero, S., Layton, C. S., Larsen, R. T. & Johnson, K. R. (2012). Efficacy of firearms for bear deterrence in Alaska. *Journal of Wildlife Management* 76: 1021–1027.
- Støen, O. G., Ordiz, A., Sahlén, V., et al. (2018). Brown bear (*Ursus arctos*) attacks resulting in human casualties in Scandinavia 1977–2016; management implications and recommendations. *PLoS ONE* 13: e0196876.
- Swenson, J. E. (1999). Does hunting affect the behavior of brown bears in Eurasia? *Ursus* 11: 157–162.
- Tak, S. R., Nabi, D. G., Halwai, M. A. & Mir, B. A. (2009). Injuries from bear (*Ursus thibetanus*) attacks in Kashmir. *Turkish Journal of Trauma & Emergency Surgery* 15: 130–134.
- Wikipedia. (2019). Willem Barentsz (WWW document). Available from https://en.wikipedia.org/wiki/Willem_Barentsz
- Wilder, J. M., Vongraven, D., Atwood, T., et al. (2017). Polar bear attacks on humans: implications of a changing climate. *Wildlife Society Bulletin* 41: 537–547.
- Wilson, E. O. (1984). *Biophilia*. Cambridge, MA: Harvard University Press.
- Windler, A. (2014). *Views towards the sun bear and frames on the human–sun bear conflict of local people in West Sumatra, Indonesia*. Wageningen: Forest and Nature Conservation, Wageningen University & Research.
- Yamazaki, K. (2004). Recent bear–human conflicts in Japan. *International Bear News* 13: 16–17.
- Yamazaki, K. (2010). *Ursus thibetanus*. In: Ohdachi, S. D., Ishibashi, Y., Iwasa, M. A., Fukui, D. & Saitoh, T. (Eds.), *The wild mammals of Japan* (pp. 243–245). Kyoto: Shoukado Book Seller.
- Yamazaki, K. (2017). Consecutive fatal attacks by Asiatic black bear on humans in Northern Japan. *International Bear News* 26: 16–17.
- Yamazaki, K. & Sato, Y. (2014). Country-wide range mapping of Asiatic black bears reveals increasing range in Japan. *International Bear News* 23: 18–19.
- Yamazaki, K., Furubayashi, K., Kasai, S., et al. (2008). A preliminary evaluation of activity-sensing GPS collars for estimating daily activity patterns of Japanese black bears. *Ursus* 19: 154–161.