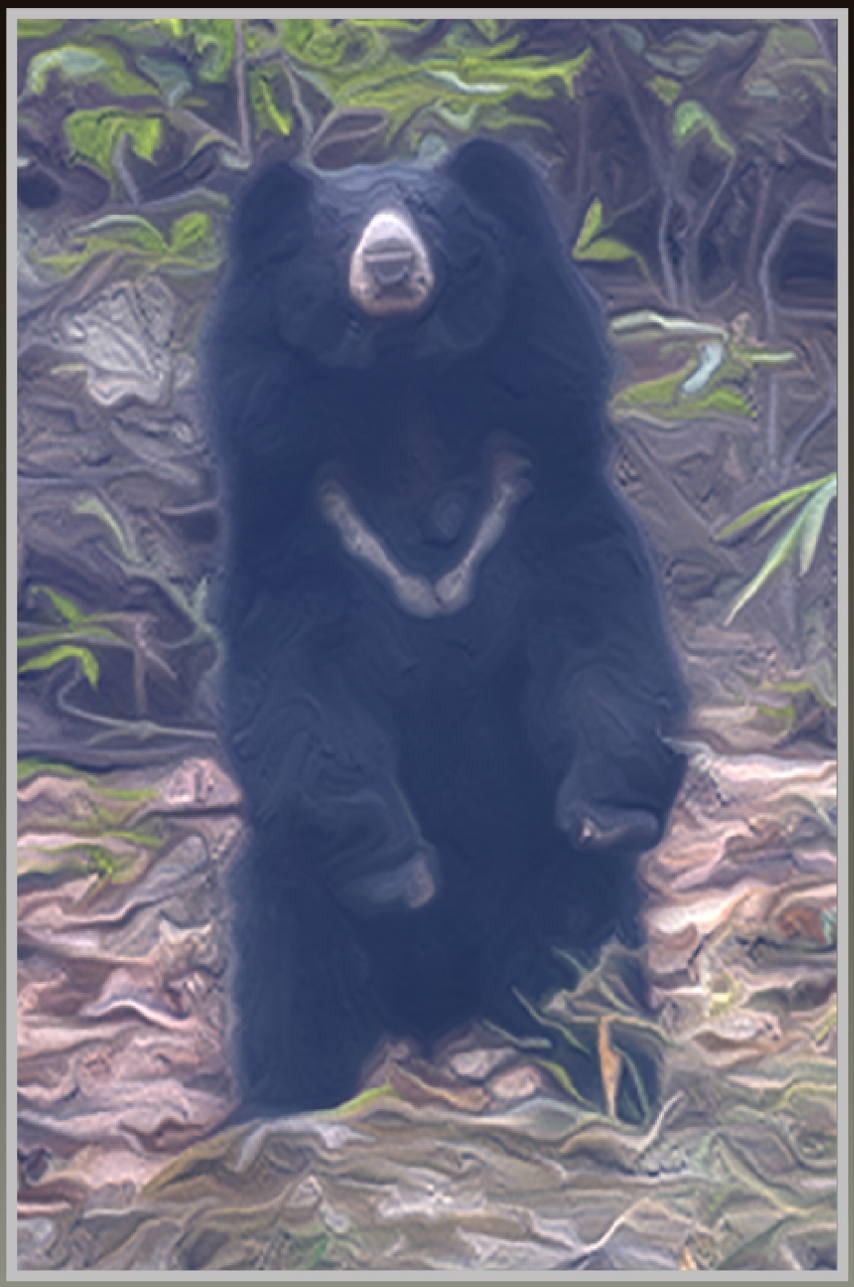
Sloth Bear Attack Behavior and a Behavioral Approach to Safety



WILDLIFE SOS

INTERNATIONAL ASSOCIATION FOR BEAR RESEARCH & MANAGEMENT

Oso, Bär, Björn, Orso, Bjørn, Samxe, 熊, Bhalou, Άρκτος

Urs, Ours, МедВедь, Bca, Medved, Beer, Shash, Běruang, Karhu, Bear

Thomas R. Sharp, Shanmugavelu Swaminathan, Attur Shanmugam Arun, Tom Smith, Kartick Satyanarayan, and Geeta Seshamani

March 2017

Sloth Bear Attack Behavior and a Behavioral Approach to Safety

Thomas R. Sharp, Shanmugavelu Swaminathan, Attur Shanmugam Arun, Tom Smith, Kartick Satyanarayan, and Geeta Seshamani

March 2017

They [sloth bears] have a reputation for attacking people without apparent reason, provided that person happens to pass too close, either while the bear is asleep or feeding, or just ambling along. So the natives give bears a wide berth; together with the elephant, they command the greatest respect from jungle dwelling folk.

—Kenneth Anderson, *Man-Eaters and Jungle Killers*

[The sloth bear] is also more inclined to attack man unprovoked than almost any other animal, and casualties inflicted by it are unfortunately very common, the victim being often terribly disfigured even if not killed, as the bear strikes at the head and face. Blanford (author of *The Fauna of British India, Including Ceylon and Burma*) was inclined to consider bears more dangerous than tigers.

—Robert A. Sterndale, *Natural History of the Mammalia of India*

Suggested citation: T. R. Sharp[1], S. Swaminathan[2], A. S. Arun[2], T. Smith[3], K. Satyanarayan[4], and G. Seshamani[4]. 2017. Sloth Bear Attack Behavior and a Behavioral Approach to Safety. Final Report to International Association for Bear Research and Management.

1. Wildlife SOS – Salt Lake City, Utah, United States
2. Wildlife SOS – Bangalore, Karnataka, India
3. Brigham Young University – Provo, Utah, United States
4. Wildlife SOS – New Delhi, India

CONTENTS

FIGURES

SUMMARY

Sloth bears (*Melursus ursinus*) are known to behave aggressively toward humans, and are believed to be one of the most dangerous wild animals in India. Although several papers have documented sloth bear attacks, no attention has been given on how to behave in sloth bear country to avoid encounters, or how to react to a sloth bear attack to minimize injuries and the likelihood of death. Wildlife SOS field research teams interviewed a total of 342 people, including 180 that had either been attacked or that had witnessed an attack, and 162 people that have had encounters with wild sloth bears that did not result in an attack. Our research and investigation confirmed that all attacks were defensive-aggressive in nature; we found no evidence for predatorial motivations. Our findings also show that people who had been making noise while moving through sloth bear country were less likely to be attacked. Our data also reveal that 9% of individuals who fought back during an attack were killed, and 11% of people who attempted to run were killed, whereas there were no deaths among people who merely fell to the ground and did not fight back. However, the data also reveal that those who fell to the ground and did not fight back were more likely to sustain serious injuries than those who did fight back.

INTRODUCTION

Sloth bears are known for their propensity to behave aggressively toward humans, and are believed to be one of the most dangerous wild animals in India (Sterndale 1884, Pillarisett 1993). It is not known exactly how many people are seriously injured or killed by sloth bears in India during a given year. Nonetheless, in the state of Madhya Pradesh, there were 48 sloth bear–related human deaths and 687 maulings between 1989 and 1994 (Rajpurohit and Krausman 2000) for an average of 6 deaths and 115 maulings per year. Compared to American black bears (*Ursus americanus*) in the United States and Canada during the last 110 years (1900–2009), there have been 63 documented human deaths due to predatory attacks (Herrero et.al. 2011). Additionally, Herrero (1985) estimates that during the past 100 years in the United States and Canada, roughly 100 people have been killed by brown bears (*Ursus arctos*).

Most people working and living in sloth bear habitat do not possess firearms or have access to bear (pepper) spray or other commonly used bear deterrents (e.g., flares, screamers, shotgun deterrent rounds). Additionally, there is currently no messaging that emphasizes the importance of bear avoidance, how to behave when encountering a sloth bear, or how to react to a charging sloth bear. Sloth bears are considered very unpredictable and often aggressive. Given the number of attacks and the associated human casualties, coupled with the lack of firearms and bear spray, a behavioral-based approach to reducing bear encounters and associated attacks in the wild could be useful for saving human lives. Such an approach has been very successful in Canada and the United States, and has helped people better understand these mammals. This study is the first comprehensive effort to identify a behavioral approach to reducing risk from sloth bears in India.

OBJECTIVES

1. Determine a sloth bear's motivation(s) for attack: defensive or predatorial.
2. Determine the circumstances under which defensive attacks occur.
3. Determine defensive behaviors that sloth bears typically exhibit.
4. Determine the most effective ways for humans to avoid sloth bears in the wild.
5. Determine the best way to react when observing a wild sloth bear, based on its behavior.
6. Determine the best way to respond if attacked by a wild sloth bear, based on its attack motivation.

STUDY AREA

Sloth bears occupy mainly lowland habitats throughout India, extending south to Sri Lanka and north to Nepal. However, Wildlife SOS works extensively in the southern Indian state of Karnataka, and so we largely interviewed people from that region, namely in the districts of Ramnagaram, Arasikere, Tumkur, Koppal and Ballary in Karnataka.

Wildlife SOS currently operates four sloth bear rescue centers across India. The Bannerghatta Bear Rescue Center (BBRC) in the state of Karnataka houses roughly 80 bears. We collected video footage of bear behavior at this facility to analyze sloth bear behavior.

METHODS

We employed the following four methods to determine the motivations behind sloth bear attacks, and the best ways to avoid encounters and attacks.

1. Literature review – We conducted a thorough literature review of past sloth bear attacks and other aspects of their ecology that could help predict wild sloth bear behavior when encountering humans. This included sloth bear diet, behavioral details of attacks, and known behavioral elements of inter- and intra-specific sloth bear interactions, including with tigers (*Panthera tigris*).
2. Interviews – We interviewed 342 people in their native language who have had a variety of encounters or observations of sloth bear behavior, including the following:
    a. People who had been attacked by sloth bears (n=180).
    b. People who have had an encounter with a sloth bear in the wild that did not result in an attack (n=162).
    c. Veterinarians and biologists who have more than 10 years of experience working with sloth bears at the Wildlife SOS sloth bear rehabilitation centers, and who have observed sloth bear behavior toward humans as well as between sloth bears.
3. Video documentation of sloth bear behavior – We recorded videos of intra-specific sloth bear interactions and behavior at the Wildlife SOS bear facilities in Agra and Bangalore as well as bear charge videos.

4. Comparison of bear behavior – We compared the behavior of sloth bears to that of bears with better understood and documented human attack behavior, namely American black (*Ursus americanus)* and grizzly (*Ursus arctos)* bears.

RESULTS

Sloth Bear Attack Motivation

We studied documented sloth bear attacks to assess motivation for attack. We initially posited that attacks would be either predatorial or defensive in nature, as is the case with North American bears. If an attack was deemed defensive, we attempted to assess whether the animal was protecting cubs, a food cache, or was surprised and therefore defensive-aggressive. If the attack did not fit any of these criteria, we set it aside for further analysis. We then looked at relationships between sloth bears and other species that could be a threat to them, namely tigers, but also other predators or megafauna.

The analysis of the data gathered indicates that sloth bear attacks appear to be wholly defensive. We did not find a single case that was clearly predatorial in nature when conducting our intensive literature review or in the attacks we documented. However, we did find accounts, both historical and contemporary, of sloth bears partially consuming human corpses—occasionally including those they had killed themselves. Our reasons for not labeling these attacks predatory is illustrated in the examples that follow.

We studied two historical accounts of sloth bear maulings that included consumption of the victim. The most famous is the "sloth bear of Mysore," which was reported to not only have mauled 24 people and killed another 12, but also partially consumed three of its victims (Anderson 1957). The second account involves the "sloth bear and cubs of Chandra," which threatened small villages for a six-week span, reportedly consuming more than one victim. More recently, Bargali et al. (2005) reported two incidents in which a bear that had killed a person remained in the area feeding on body parts. However, because we do not know how this event unfolded, we cannot reasonably conclude what the bear's initial motivation was.

During our interviews, 4% (n=7) of victims claimed their attack to have been predatorial. It is important to recognize that a non-predatorial attack could easily *appear* predatorial from the victim's perspective, especially if there seemed to be no other apparent motivation for the confrontation. Additionally, sloth bear attacks tend to focus on the victim's head region, leading some to believe the attack was predatorial; however, focusing on the head and face does not appear to be linked to predatorial attacks in bears in general (Smith et al. in review) but is indicative of the attack strategy. Herrero (1985) surmised that bears attack the head and neck region largely because they perceive our teeth as a weapon threat, the same as they would with conspecifics.

The lack of evidence for sloth bear predatorial attacks is consistent with their diet (Joshi et al. 1997, Garshelis et al. 2008). These studies indicate that red meat is only rarely a component in the normal diet of a sloth bear. Although the occasional small rodent or reptile has been found in sloth bear scat, even these food types are likely ingested incidentally while foraging for insects and grubs. Similarly, T. Smith (personal communication) has found bees (*Bombus* spp.) in brown bear scat, incidentally ingested while

foraging on the inflorescences of cow parsnip (*Heracleum lanatum*). There is no evidence to suggest that sloth bears purposely forage for even small mammals. However, sloth bears are known to occasionally scavenge on larger mammals, including humans. In 1995, Kartick Satyanarayan found a human index finger in a sloth bear scat during a tiger-scat collection drive on a research project in Central India. It was later confirmed that a tribal burial site was nearby, and the bear scavenged on a human corpse that had been excavated by other scavengers.

Perhaps Kenneth Anderson said it best roughly 60 years ago (Anderson 1957) when he wrote the following about the famous sloth bear of Mysore case:

> Local rumors had it that the bear had taken to eating its victims, the last three of whom had been partly devoured. I had no opportunity to verify the truth of these rumors but felt that they might be true to some extent as the Indian sloth bear is a known devourer of carrion at times, although generally he is entirely vegetarian, restricting himself to roots, fruit, honey, white ants [termites] and similar delicacies. So fresh meat, even human meat, might not be unwelcome.

It is possible that scavenging on the remains of humans, especially those that the bears themselves killed, has led to the belief that sloth bears prey on people. Consuming a victim initially attacked for defensive reasons is not unique to sloth bears; it has also been described in grizzly bear literature (Herrero 1985). It is likely that the bear is simply being an opportunistic omnivore by feeding on human flesh.

Defensive Attacks: Circumstances

Grizzly bear defensive attacks can be subdivided into four categories 1) a mother protecting her young, 2) a bear protecting its food cache, 3) a surprise encounter, and 4) a harassed bear. Our data and the literature suggest that defensive sloth bear attacks are motivated by three of these four categories—the protection of young, surprise encounters, and harassed bears. We have found no cases of a sloth bear attacking to protect a food cache.

The “harassed bear” category refers to attacks provoked by human harassment (often chronic) that leads to a bear charge and physical contact. For sloth bears, this category varies a bit from how it is used for grizzly bears. This type of harassment in the case of sloth bears often includes people throwing objects and yelling at the bear. This situation can also escalate into what is termed an “attack spree.” These are cases in which a harassed bear kills multiple people in what appears to be self-defense, usually because the bear appears unable to escape, or is motivated to become aggressive by the overall threat of the situation. It therefore feels forced to confront one person after another. Attack sprees have been documented between brown bears and humans in Alaska (T. Smith, personal observation), though sloth bear attack sprees last longer and appear, at least superficially, to put the animal in more of a frenzied state.

During our interviews with 181 sloth bear attack victims, almost half of the attacks (n=84, 46%) involved a female with dependent young. These cases fall under the “mother protecting her young” category. Of the 161 encounters that were reported and did not end in an attack, 40% (n=65) involved a female with dependent young.

Of the 181 attacks, 52% (*n*=94) involved single bears. The motivation for these attacks was most likely due to surprise encounters. Single bears accounted for 60% (*n*=96) of the encounters that did not result in an attack. The remaining 2% (*n*=3) of attacks involved a pair of bears.

Defensive Behaviors

Grizzly bear defensive behavior such as laying their ears back, slapping the ground, jaw popping, and huffing are well documented. Sloth bear defensive behaviors have not been explicitly documented. The ears being drawn or pinned back is a common defensive reaction among bears and many other species of wildlife (e.g., felids and canids). However, this behavior is rarely, if ever, exhibited by sloth bears. Sloth bear charge videos taken by Wildlife SOS and other wildlife videographers show that sloth bear ears are not laid back during a charge. Additionally, sloth bear ears do not appear pulled back during tiger encounters (http://www.arkive.org/tiger/panthera-tigris/video-ti11b.html). Aditya Dicky Singh's 10-photograph series of a tiger/sloth bear interaction (http://www.dickysingh.com/2011/04/10/bear-tiger-confrontation-10-pics-that-tell-a-story/) provides several interesting details. One photograph (Figure 1) clearly shows the heads of each animal during the most intense moments of the confrontation. The contrast is remarkable; while the tiger clearly has its ears pulled back, the sloth bear does not; in fact, the bear's head appears larger than usual. The sloth bear's shaggy head potentially conceals drawn-back ears, rendering them useless as a means for communicating stress. Additionally, it seems possible that the fur on the head makes the bear appear larger and thus more intimidating. Pulling back the ears would potentially make the head look smaller. Another tiger/sloth bear confrontation photographed by Julien Boulé shows a sloth bear aggressively squaring off with a tiger and holding its ground (Figure 2). Once again, the tiger's ears are pulled back while the sloth bear's are not.

Figure 1. Sloth bear/tiger encounter demonstrating the appearance of a very large sloth bear head (photograph by Aditya Dicky Singh).

Figure 2. Sloth bear/tiger interaction demonstrating a sloth bear's aggressive stance toward a tiger; the bear's ears are not pulled back in a defensive posture (photograph by Julien Boulé).

Sloth bears may also attempt to look larger by getting up on their two hind legs during attacks on humans or in encounters with tigers. A bear on two hind legs will appear larger and more intimidating (Figure 3). A bipedal bear also brings all three weapons, two paws and its teeth, into play simultaneously, presenting a formidable threat to would-be attackers.

Figure 3. Sloth bear/tiger interaction demonstrating the sloth bear's predilection to rise onto two hind legs during a dangerous encounter (photograph by Aditya Dicky Singh).

Sloth bears, unlike most other bear species, are very vocal, and will actively voice their uncertainty and discomfort with a situation. However, only 4% of the attack victims (n=7) noted that the bear vocalized before it charged and made physical contact. Yet it is clear in video of sloth bear charges and sloth bear/tiger interactions that bears are markedly vocal during such encounters. A Wildlife SOS video from the BBRC captured a vocalization that sounds more reminiscent of a gorilla's charge than a bear's. It seems clear that these vocalizations add a startling and intimidating element to the charge.

Overall, sloth bears appear to forego the subtle defensive/stress displays that grizzly bears and American black bears make when warning people or other animals that their stress level is rising. However, sloth bears do use several methods to intimidate a potential threat, after which an attack may or may not occur.

Avoiding Encounters in the Wild

We asked the interviewees involved in 181 bear attacks if they had been making noise before the encounter. Roughly two-thirds (n=111, 67%) stated that they had not been. We also analyzed sloth bear encounters that did not result in an attack or physical contact. Of the 126 interviewees who experienced

a sloth bear encounter without an attack, and could recall if they were making noise, 78% (*n*=98) claimed to have been making noise, whereas 22% (*n*=28) had not been.

Injuries and Responses to Attacks

To identify potential patterns, we assessed the severity of bear-attack injuries based on how the victim reacted to the confrontation. Our intent was to identify responses that resulted in the least amount of bodily injury. We paid particular attention to the three most common responses to an attack: 1) fighting back, 2) running, and 3) falling to the ground and not fighting back.

Fighting Back

We interviewed 69 individuals involved in separate incidents who fought back when attacked (or who had witnessed it). Approximately 9% of these people were killed, 12% were severely injured, and 50% suffered minor injuries (Figures 4 and 5).

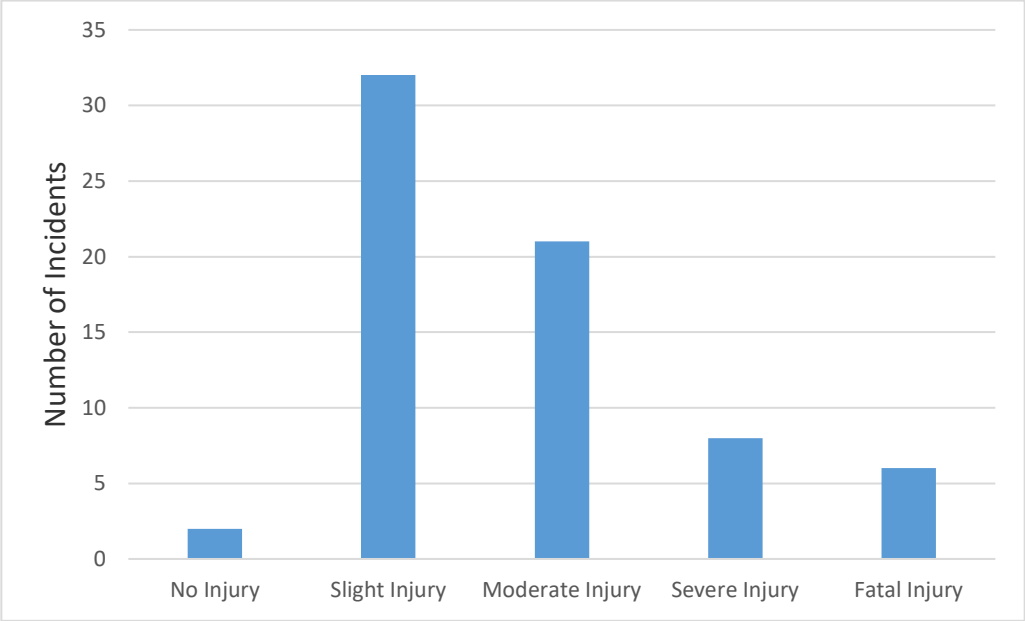


Figure 4. Number of incidents (*n*=69) by injury type that resulted from fighting back with an attacking sloth bear.

Running

We interviewed 64 individuals who were attacked by a sloth bear (or witnessed an attack) when attempting to run away. In all, 11% that ran were ultimately attacked and killed. Another 9% were severely injured, and 42% suffered moderate injuries (Figures 6 and 7).

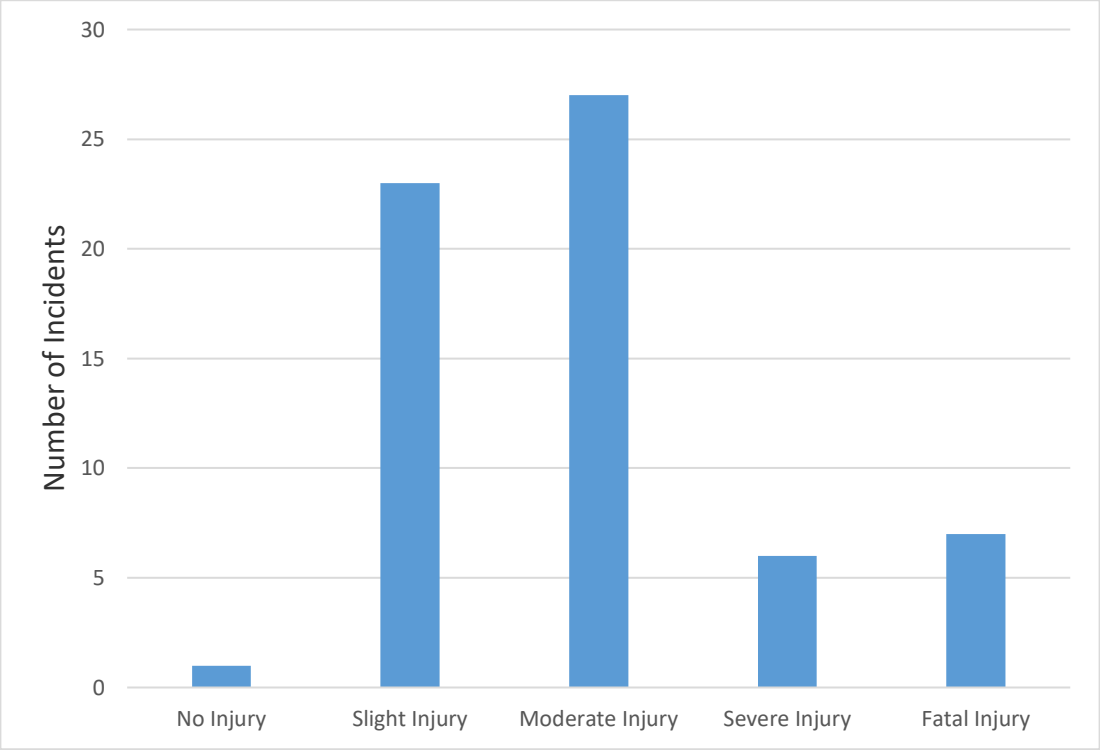


Figure 5. Number of incidents (*n*=64) by injury type that resulted from running from an attacking sloth bear.

Playing Dead (Falling to the Ground and Not Fighting Back)

We interviewed 23 individuals who played dead (i.e., fell to the ground and did not fight back) when attacked. No individuals who played dead suffered fatal injuries. However, 18% of those playing dead suffered severe injuries, while 65% incurred moderate injuries (Figures 8 and 9).

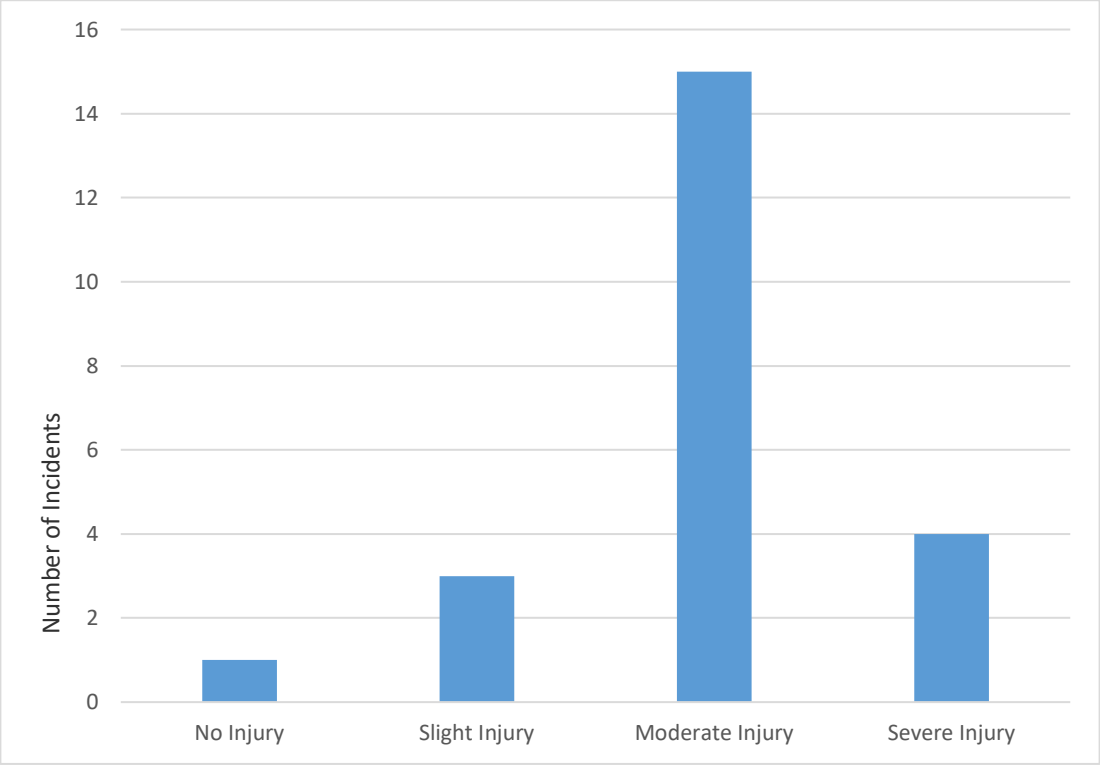


Figure 6. Number of incidents (*n*=23) by injury type that resulted from playing dead with an attacking sloth bear.

Comparison to Other Bear Species

Although anecdotal reports of bear attacks on humans exist for the polar bear (*Ursus maritimus*), Asiatic black bear (*Ursus thibetanus*), Andean bear (*Tremarctos ornatus*), panda bear (*Ailuropoda melanoleuca*), and sun bear (*Ursus malayanus*), American black bear and grizzly/brown bear attacks have been the most studied and best understood. Importantly, the grizzly bear accounts for more than 80% of all bear attacks in North America (Herrero 1985, Smith et al. in review), even though they are far outnumbered by black bears. Smith et al. (in review) report that grizzly bears are 26 times more likely to engage in conflict with humans than are black bears, and 6 times more likely than polar bears. Nonetheless, bear attacks in North America have averaged 7.6 attacks/year in the last decade (Smith et al. in review). This level of human-bear conflict pales in comparison to that of human–sloth bear conflict in India. Although data are lacking for the entire country of India, human-bear conflict statistics from a single Indian state prove this point. Rajpurohit and Krausman (2000) documented sloth bear attacks in the state of Madhya Pradesh from 1989 to 1994. They found that sloth bears inflicted 48 fatalities and 687 maulings during a 6-year period, for an average of 123 attacks/year, 16 times more than the entire state of Alaska for the same time. From this perspective, the sloth bear appears to be a far greater threat to human safety than any bear species on the North American continent. However, differential contact rates with humans clearly play a role in these statistics. Whereas the human density in North America is roughly 22.9/km^2, it is reported to be 389.9/km^2 for India, or approximately 17 times greater. Just as this differential population density correlates highly with the difference in bear attack frequency between

North America and India, Smith et al. (in review) demonstrated that population growth in Alaska over 130 years accounts for 87% of the variation in bear attacks during the same period. Indeed, the more people enter bear habitat and commingle with them, the more likely are human-bear encounters and risk of subsequent injury and/or death, whether grizzly or sloth bear. We do not conclude, therefore, that sloth bears are more dangerous than grizzlies, but rather that they are quite similar in their intolerance of human incursions into their habitat.

DISCUSSION

Attack Motivation

Historical data and recent interviews with attack victims and witnesses all support the premise that the motivations of sloth bear attacks are exclusively defensive in nature, not predatorial. In fact, we were unable to document or find documentation for a single sloth bear predatorial attack. Occasionally a victim reported an attack as predatorial, and though these attacks do not appear predatorial when independently analyzed, we understand how they could appear as such. Attack victims have reported feeling ambushed by an animal lying in wait because the bear appeared to be hidden and therefore could have likely left the area without ever being detected. It then follows that people might conclude that the motivation for attack was predatory. Other victims reported seeing a sloth bear hiding behind a tree, only to attack after detection. Again, this appeared to the victim as predatorial. However, video footage of a stressed bear at the BBRC shows it running behind a tree, only to charge again at people outside its fenced area. The attack might look predatorial because it seems logical that a non-predatorial bear would either stay hidden or run off rather than attack.

Another contributor to the belief that sloth bears may be predatorial is the existence of documented cases, both recent and historical, of sloth bears partially consuming their victims' corpses. However, upon closer inspection, it appears that the initial bear attacks in these cases were defensive in nature (or at the very least the motivation is unknown), and that the bears began consuming the corpse(s) opportunistically. As we mentioned, sloth bears do occasionally scavenge larger mammals (Schaller 1984). Additionally, other bears (specifically, grizzlies [Herrero 1985]) have been documented feeding on victims killed during defensive attacks.

The known ecology and diet of the sloth bear seems to corroborate the lack of predatorial attacks. It is clear from studies (e.g., Laurie and Seidensticker 1977, Gopal 1991, etc.) that red meat plays nearly no role in the diet of this species. Red meat is generally limited to the occasional rodent, which was likely consumed inadvertently while the bear foraged for insects. Even scavenging on wildlife carcasses appears rare for this species.

The sloth bear's defensive nature appears to be the result of co-evolving with large predators, namely tigers, which are known to occasionally kill and eat sloth bears. However, it is instructive to compare the sloth bear's survival strategy to that of the American black bear. Although the sloth bear behaves defensively aggressive, the American black bear almost never attacks defensively. Even a female with cubs will run in the face of danger, while the cubs climb trees. Sloth bear cubs do not climb trees when threatened, but rather cling to their mother's back for the first 9 months of their lives. Mother sloth bears

with cubs have been documented fighting off tigers by charging them with cubs clinging to their backs. The reasons for this difference in strategies between black and sloth bears may be explained by differences in their respective habitats and the other species of wildlife occupying them. American black bears are largely restricted to forested habitats, whereas sloth bears are often found in grasslands and scrub jungle, where the opportunity to climb a tree is not always present. Additionally, though sloth bears occasionally climb trees for honey and other foods, they are not nearly the climbers that American black bears are. This may be partly due to the sloth bear's very long claws, which are adapted to digging rather than climbing trees. The tendency of sloth bears to attack without much provocation could have evolved as a way to mitigate threats in their environment. Bouskila and Blumstein (1992) state that "animals rarely have perfect information, and generally are expected to maximize fitness by overestimating rather than underestimating risk. Overestimation costs, such as lost feeding opportunities, have milder fitness consequences than the cost of underestimating danger, which might be immediate death." Frid and Dill (2002) concur with this assessment, stating that underestimating a potential risk has much harsher consequences than overestimating a perceived threat. Sloth bears are mid- to small-sized bears that coexist with many predatorial species such as tigers and leopards (*Panthera pardus*) as well as megafauna such as the Asian elephant (*Elephas maximus*) and Indian rhinoceros (*Rhinoceros unicornis*). Although sloth bears flee potential danger when given the chance, they often use the strategy of "the best defense is a good offense," and charge the putative threat.

North American bear species (black, brown/grizzly, and polar) have been known to see humans as potential prey. We did not find predation to be a motivation for sloth bear attacks in India; most are the result of surprise encounters. This is important because it suggests the solution to sloth bear-human conflict lies in human behavior modification rather than arming people with expensive deterrents (e.g., firearms, bear spray, shotgun deterrent rounds), an economic impossibility for most. If a person acts appropriately in sloth bear habitat, making noise and telegraphing their presence as they move about, our research suggests that most bear encounters will be avoided. When avoidance measures (i.e., making noise appropriately, hiking in groups, etc.) are the focus of bear safety messaging, the nuances of how to best defend oneself during an attack (e.g., fight or flight) become much less important.

Defensive Behaviors

Sloth bears do not appear to display signs of stress before charging. This may be related to the species' predilection to charge with less provocation than bear species such as grizzlies or American black bears. Sloth bears do appear to incorporate several actions meant to intimidate, including vocalizing and raising up on their hind legs. Sloth bears may also use their shaggy fur to appear larger to potential predators.

Notably sloth bears do not pull their ears back during a tiger encounter. Since tiger attack sites are typically the back of the neck, pulling one's ears back is not particularly useful. Work by Walther (1969) and Ghalambor and Martin (2000) suggests that prey have evolved predator-specific antipredator behaviors. This may be the case here: no need to pull ears back for tigers whereas they may do so with other sloth bears. Further observation of sloth bear-sloth bear aggression is required to determine if sloth bears behave differently to different types of threats. Bear-bear attacks in North America are generally frontal attacks of the head and face, and as such laying the ears flat makes more sense.

Avoiding Encounters in the Wild

Our data strongly suggest that making noise while moving through sloth bear habitat helps to avoid sloth bear encounters and attacks, and that encounters are less likely to turn into attacks. This suggests that if the bear is not startled in close quarters, its preference is to leave the area without incident. This is not surprising, and is similar to findings with other bear species, namely the grizzly and American black bear.

How to React to a Sloth Bear Attack

The results of our interviews aimed at determining a behavioral approach to sloth bear attacks yielded some mixed messages. Fighting an attacking sloth bear resulted in approximately 9% fatalities, while running from an attacking sloth bear resulted in 11% fatalities. Playing dead when confronted by an attacking sloth bear resulted in no fatalities. Therefore, if the goal is simply to survive the encounter, falling to the ground and covering up in some fashion seems advisable. However, if we combine fatalities with serious injuries, all three courses of action result in approximately 20% of individuals being killed or severely injured. Further, a higher percentage of people who played dead and covered up in some fashion suffered a higher rate of moderate injuries (65%) than did those who fought back (30%) or those who ran (42%). The reasons for this are difficult to interpret; however, a partial explanation may be that those who played dead did not cover up in the most protective manner. In fact, what many of the victims reported doing while playing dead does not constitute effective protection. Therefore, it is at least possible that if people were taught how to properly protect their head and neck regions from injury, the severity of the injuries would lessen.

Those who fought back and did not die faired relatively well, as only 46% suffered minor injuries. However, 9% were fatally injured and another 12% were severely injured. We are unable to ascertain why nearly half of the victims escaped with minimal injuries while 21% were killed or severely injured. The differences in injury may have to do with some unreported action on the victim's part that resulted in greater injury. It may also merely reflect the odds of an injury being severe or fatal. When a bear's jaws encompass the head, injuries are most often fatal, whereas when canines slip off the curvature of the skull, severe injuries result but the brain remains protected. With this in mind, one can see how under the same attack scenario, one individual may die while another might survive.

Finally, those who attempted to run from the attacking bear fared worst, with a higher percentage dying than in the other response scenarios (11%). There is little doubt that running triggers a chase response in sloth bears, just as it does in grizzly bears (Herrero 1985). There have been many cases of sloth bears chasing, catching, and mauling human victims (Sharp and Sonone 2011).

Future Directions

Further follow-up studies on sloth bear attacks and responses to victim behavior will help confirm if reacting to a sloth bear attack in the same manner as to a defensive grizzly bear attack would be most beneficial for the victim. Additionally, outreach to communities in sloth bear habitat can educate them on them how to avoid encounters with sloth bears, or what to do if they are charged and attacked.

ACKNOWLEDGMENTS

We appreciate the funding from the International Association of Bear Research and Management. We would also like to thank the Forest Department of the State of Karnataka for sharing their sloth-bear attack records, which were instrumental in allowing us to conduct a number of interviews with bear attack victims. We acknowledge the Wildlife SOS Field Research Team of Reagan, Balasubramaniam, and Yogaraj for the persistent and extensive data gathering to make this publication possible. We thank the Wildlife SOS BBRC team who extended their support for gathering photo and video documentation. Finally, we extend a special thank you to Aditya Dicky Singh and Julien Boulé, who allowed us to use their sloth bear/tiger encounter photographs for this report.

LITERATURE CITED

Anderson, Kenneth. 1957. *Man-eaters and jungle killers.* George Allen and Unwin Ltd., London.

Bargali, H.S., N. Akhtar, and N.P.S. Chauhan. 2005. Characteristics of sloth bear attacks and human casualties in North Bilaspur Forest Division, Chhattisgarh, India. *Ursus* 16:263–267.

Bouskila, A. and D.T. Blumstein. 1992. Rules of thumb for predation hazard assessment: predictions from a dynamic model. *American Naturalist* 139:161–176.

Burton, R.G. 1856. *A book of man eaters by Brigadier General R.G. Burton*. Mittal Publications. Delhi, India.

Frid, A. and L. M. Dill. 2002. Human-caused disturbance stimuli as a form of predation risk. *Conservation Ecology* 6(1):11. Available at: http://www.consecol.org/vol6/iss1/art11.

Garshelis, D.L., S. Ratnayeke, and N.P.S. Chauhan. 2008. IUCN SSC Bear Specialist Group: *Melursus ursinus.* The IUCN Red List of Threatened Species.

Ghalambor, C. K., and T. E. Martin. 2000. Parental investment strategies in two species of nuthatch vary with stage-specific predation risk and reproductive effort. *Animal Behaviour* 60:263–267.

Gopal, R. 1991. Ethological observation on the sloth bear (*Melursus ursinus*). *Indian Forester* 117: 915–920.

Herrero, S., A. Higgins, J.E. Cardoza, L.I. Hajduk, and T.S. Smith. 2011. Fatal attacks by American black bear on people:1900-2009. *Journal of Wildlife Management* 75(3):596–603.

Herrero, S. 1985. Bear attacks: their causes and avoidance. Winchester, Piscataway, New Jersey.

Joshi, A. R., D. L. Garshelis and J. L. Smith. 1997. Seasonal and habitat-related diets of sloth bears in Nepal. *Journal of Mammalogy* 78:584–597.

Laurie, A., and Seidensticker, J. 1977. Behavioural ecology of the sloth bear (Melursus ursinus). *Journal of Zoology* (London) 182:187–204.

Pillarisett, A.M. 1993. *Are sloth bear man marauders? Two decades of project tiger, Melghat (1973–1993)*. Edited by M.G. Gogate and P.J. Thorsare. Melghat Tiger Reserve, Melghat, India.

Rajpurohit, K.S. and P.R. Krausman. 2000. Human–sloth bear conflicts in Madhya Pradesh, India. *Wildlife Society Bulletin* 28:393–399.

Schaller, G.B. 1984. *The deer and the tiger: a study of wildlife in India*. University of Chicago Press. Chicago, Illinois.

Sharp, T. and S.D. Sonone. 2011. Sloth bear attacks: causes and consequences. *International Bear Newsletter* 20(1):14–17.

Smith, T. S. and S. Herrero. In review. Human-bear conflict in Alaska: 1880-2015. *Journal of Wildlife Management.*

Sterndale, R.A. 1884. *Natural History of the Mammalia of India and Ceylon*. Thacker, Spink, and Co., London and Calcutta.

Walther, F. R. 1969. Flight behaviour and avoidance of predators in Thomson's gazelle (Gazella thomsoni:Guenther 1884). *Behaviour* 34:184–221.