

BEAR ATTACKS

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INTRODUCTION

Bears are one of the most widely distributed animals in the world. At least one of the eight bear species currently exists in Asia, Europe, North and South America, and the Arctic (Table 43-1). Bears in Africa became extinct several million years ago. Australia and Antarctica are the only continents where bears have never existed. The koala bear of Australia is a marsupial and not a true bear.

Bears also occupy a wide variety of habitats, including tropical forests, polar ice sheets, swamps, barren ground tundra, bamboo jungles, alpine meadows, and coniferous and deciduous forests. Their range extends from sea level up to about 6100m (20,000 feet).

Bears are carnivores. Although some bear species practice specialized feeding in response to their habitat, all bears are also omnivores and retain the ability to feed on a variety of food types, including vegetation, insects, and meat.

Modern bears have larger brains than their extinct ancestors (22,30), and the relative brain size for bears is larger than that of other carnivores (14). This greater brain size probably resulted from a need to increase sensory and perceptual capacities for locating an omnivore food base with both seasonal and annual variations in distribution and abundance (5,8,25). The larger brain size reflected the increased intelligence required by bears to develop a complex foraging strategy. Increased intelligence also allowed them to develop individual behavior, shaped by both experience and memory. Thus they possess a wide variety of behaviors and have been described as playful, lazy, doleful, entertaining, intelligent, caring, powerful, aggressive, terrifying, and vicious (33).

The image of bears as “man-eaters” ignites our fear of them. Human injury and deaths from natural phenomena, especially wild animal attacks, are sensationalized. Bear attacks are rare, but the psychological impact of widespread media coverage inflates their frequency and significance (6,24). Every bear attack is traditionally referred to as a *mauling*, regardless of the extent of injuries. This term contributes to the emotional response regarding such attacks and leads to “bearanoia” in many people who visit bear country. This fear of bears may affect how people use wilderness areas with bear populations and how they view the conservation of bears and their habitat. Better understanding of bears and their behavior helps reduce bear attacks, assists physicians in treating bear attack victims, and promotes conservation of bears.

NORTH AMERICAN BEARS

Grizzly bears (*Ursus arctos horribilis*) are larger and more heavily built than most other ursids, with adults weighing 146 to 383 kg (325 to 850 pounds) (1) (Figure 43-1). Polar bears (*Ursus maritimus*) are similar in size and weight but are more elongated in shape (Figure 43-2). Black bears (*Ursus americanus*) have the same general shape of grizzly bears but are generally smaller than both polar and grizzly bears (Figure 43-3). Weights for black bears range from 63 to 135 kg (140 to 300 pounds) for adult females and 113 to 293 kg (250 to 650 pounds) for adult males.

Dentition in these three species is bunodont and reflects their omnivorous diet, although polar bears are the most carnivorous of the three (Figure 43-4). Their canine teeth are sturdy and can reach a length of 7 cm (2 3/4 inches). Their legs are of approximately equal length and taper to large, plantigrade feet. The fore claws of a grizzly bear are heavier, longer, and straighter than those of a black bear and can reach a length of 8.75 cm (3 1/2 inches) measured along the external curvature (35) (Figure 43-5). A large muscular hump overlies the scapulae of grizzly bears, giving additional strength to the forelimbs for digging (Figure 43-6). The face of a brown bear tends to be more dish shaped than that of a black bear (Figure 43-7).

The physical strength of bears is tremendous, and they can run at speeds up to 65 kph (40 mph) over irregular terrain. They have a keen sense of hearing and an even keener sense of smell. Their eyesight has been described as poor (19), although many field researchers believe that bears can actually see as well as humans and are especially adept at detecting movement. Evidence suggests grizzly bears have good night vision (11).

Grizzly and black bears hibernate about 5 months during the winter, an evolutionary adaptation to reduced food availability. The hibernation of polar bears is slightly different, since their primary food (seals) is available during the winter (28). Adult male polar bears tend to hibernate for short periods each winter in response to severe storms, whereas pregnant females have more extended hibernation. During the active (nondenning) season, all bear species wander throughout a general home range in search of seasonal foods.

The guard hairs on brown bears can be lighter in color and lend a "grizzled" appearance. Black bears can be many colors, ranging from white to black, cinnamon, brown, or "blue" (9).

GRIZZLY BEARS

The grizzly bear symbolizes wilderness in North America. In certain respects, "grizzlies" define the "wild" in wilderness. They range from Alaska down through

western Canada and into the lower 48 states in remnant populations located in relatively undeveloped federal lands, primarily in the northern Rocky Mountains.

Attacks by grizzly bears are relatively rare and sporadic. A total of 162 bear-inflicted injuries (including deaths) were reported from 1900 through 1985 in Canadian and North American national parks (19,20). From 1980 to 1994, 21 grizzly bear attacks, including 2 deaths, occurred in Yellowstone National Park (18). In Alaska the number of people injured by grizzly bears increased in recent times (26), possibly from increased in recreational use of grizzly habitat, which will probably continue.

Calculation of an accurate injury rate remains elusive. Earlier records were incomplete, and defining and quantifying those at risk has always been difficult. Injury rates are based on total visitation days to the national parks in Canada and North America (20). The average number of grizzly bear-inflicted injuries is 1 in 2,260,276 visitors to these parks combined, with a high of 1 in 317,700 visitors in Kluane National Park and a low of 1 per 6,693,859 visitors in Banff. During this same period the grizzly bear-inflicted injury rate for Yellowstone National Park was 1 in 1,543,287 visitors and for Glacier National Park was 1 in 848,180 visitors.

Not every visitor to a national park is exposed to the same risk of being attacked by a grizzly bear. To calculate an injury rate more accurately for visitors with a higher and more uniform exposure, similar rates are reported based on registered backcountry users. However, this method provides an inaccurate injury index because some parks do not register backcountry use and others generally underestimate it. Also, a significant and perhaps most backcountry use (and therefore exposure) is by unregistered day hikers.

The number of bear attacks (both black and grizzly) increases in months when more people recreate in grizzly country. For national parks the incidence of bear attacks increases during the peak tourist season, July and August. For surrounding national forests another peak occurs during hunting season, September to November. With more people recreating in bear country, greater opportunity exists for human-bear encounters.

Native peoples and grizzly bears occupied the same land for thousands of years in North America in what was probably a neutral coexistence, since neither side had a profound influence on the other. However, the European expansion into the west following Lewis and Clark's expedition in the early 1800s tipped the scales heavily in favor of humans, both in sheer numbers and technology, such as guns, traps, and poisons. Bears were killed in large numbers to appease fear and hatred and to protect life and property. Most of their original habitat was occupied by either people or livestock or was dramatically altered by ranching and agricultural development.

Selection pressures that began with European expansion into the grizzly bears' habitat has probably been altering their behavior. Since that early period and even today in protected areas such as national parks, aggressive bears have been removed at a higher rate than nonaggressive bears. Bears that were curious about humans and human developments and those that did not readily flee the presence of humans were also

removed at a higher rate. Therefore bears that avoided humans survived at a higher rate than other bears and probably passed that trait on to their offspring through genetics and learning.

A built-in safety factor exists for people entering grizzly country because the vast majority of bears now avoid a confrontation if given the opportunity, which probably explains why grizzly bear attacks on humans are so rare. Unfortunately, the available information on grizzly attacks does not always yield an accurate account of the cause-and-effect relationship. The specific sequence of events is not always known and is subjectively reconstructed, although case histories reveal certain patterns.

A sudden and close encounter with a grizzly bear is the primary event leading to human injury. From 1980 to 1994, of 21 people injured by grizzlies in Yellowstone National Park (18), 18 resulted from people surprising a grizzly at close quarters. These attacks were often brief, and the bear generally left the area soon after the attack. Although injuries were typically described as a mauling, they were generally much less severe than the bear had the potential to inflict, and victims were rarely killed. This suggests that the bear's behavior in response to a close encounter was to remove a perceived threat.

A close encounter with a female with cubs is considered more dangerous, since she is considered to be more aggressive in defense of her young (Figure 43-8). Evidence to support this hypothesis is strong. Females with young represent about 20% of a bear population but account for more than 80% of the bears that injure humans. Another explanation, however, is that females with young are more likely to be active during daylight hours when humans are active, whereas males are active primarily in the predawn hours and after dusk (11).

Grizzly bear attacks sometimes occur near a carcass on which the bear has been feeding. Grizzly bears may be more aggressive under these circumstances in defense of the carcass. Grizzly bears of all ages and either gender, however, may readily exit when they sense people approaching (12). When grizzly bears injure someone near a carcass, the precipitating event may simply be a close encounter with a preoccupied bear.

Another class of grizzly bear attacks results from provocation, most often when a grizzly bear is shot. Once the bear is injured, its behavioral response is no longer to remove a threat but to fight for life. These attacks tend to be more prolonged and aggressive, resulting in more severe injuries than those resulting from a close encounter.

Provoked bear attacks can result from direct harassment by aggressive photographers. Although such incidences are rare, these attacks tend to resemble the response of an injured bear rather than one responding to a close encounter. The injuries tend to be more severe, and a disproportionate number of photographers are killed. Up to 1985, at least 10 photographers were injured, one fatally, and from 1986 to 1992, at least four were injured, two fatally (19).

Most people attacked by grizzly bears are injured but not killed; the intent of the bear under such circumstances is simply to remove a perceived threat, not to prey on the individual. From 1900 to 1979, 19 human deaths resulted from grizzly attacks documented in the national parks in North America, and 22 deaths occurred in Alaska outside the parks (19,24). Some were victims of defensive attacks and probably would have survived if current medical management techniques had been available. Some deaths, however, resulted from predatory attacks. The question is why grizzlies do not prey on humans more often. As a potential prey species, humans are predictable and abundant, easy to catch and kill, and easy for a grizzly to consume.

Little historical evidence suggests that grizzly bears preyed on humans as a routine except in unusual circumstances. In 1860, a smallpox epidemic struck a small band of Stonie Indians (Assiniboin Tribe) camped in the Yarrow Creek drainage in Alberta, Canada (32). Grizzlies began scavenging on the dead left on the ground as the tribe moved to the next drainage. Grizzlies followed them to their next encampment and began preying on survivors. For years the Indians avoided this area for fear of being eaten by grizzlies that had “learned” to prey on humans.

Since about 1900, when reasonably accurate records were first kept, predatory attacks on humans by grizzly bears generally have been rare, sporadic, and isolated events (16,26,27,32,36,37). However, a disturbing trend has begun in recent times. Between 1967 and 1986, 12 deaths were inflicted by grizzly bears in Banff, Glacier, and Yellowstone National Parks. In each case the offending bear was conditioned to human foods (regularly seeking out and obtaining it) and/or habituated to human presence (not readily fleeing). Nine of the victims were partially consumed, and eight deaths were classified as predatory events (19). During this same time period, however, many bears with these same behavioral traits did not prey on humans. Conditioned and habituated behavior may predispose some grizzlies to prey on humans within their image under certain but still unknown circumstances. The relationship between conditioning and habituation appears strong, but is not conclusive. The bear involved was not always known, and the terms “conditioned” and “habituation” are borrowed from learning theory and have never been precisely defined by wildlife biologists. This potential relationship, however, has significantly influenced grizzly bear management. The primary thrust currently is to prevent bears from obtaining human foods and from routinely being around people and human developments.

Grizzly bears may also mistakenly perceive a person as one of their normal prey species. Five such incidences have been documented. Two victims were killed by grizzly bears while making prey calls to lure in other predators. Two victims were attacked while field-dressing a game animal, and the fifth was attacked while carrying the hide of a deer draped over his shoulder. Clearly, persons should not look, smell, or sound like a prey species when in grizzly country.

BLACK BEARS

Black bears are the most numerous and widely distributed of all North American bears (Figure 43-3). They occur in more than 30 of the lower 48 states, from Maine to Florida and from California to Washington. They also occur throughout Canada and Alaska, extending up to treeline below the Arctic Circle. They are well adapted to an arboreal habitat and prefer to eat vegetation, carrion, and mast (nuts, acorns), with small mammals and insects accounting for less than 5% of their diet (9).

Between 1960 and 1980, more than 500 people were injured by black bears, but at least 90% of these episodes resulted in minor scratches or bites inflicted by bears that were either conditioned to human foods or habituated to human presence (19). Injuries as a result of close encounters are extremely rare, and in contrast to female grizzly (brown) bears, female black bears display little aggression in defense of their young, and rarely cause injury. They have short, sharp radial claws better adapted for climbing trees than for attacking humans. They will often retreat rather than attack, even in defense (9).

Whereas grizzly (brown) bears sometimes prey on humans at night, black bears occasionally prey on humans during the daytime. From 1900 through 1980, 20 people were killed by black bears, with predation considered the motivation in 18 cases. All but one case occurred in remote areas outside park boundaries, an indication that neither conditioning nor habituation was a major factor.

Since 1985, black bears attempted to prey or preyed on humans in 15 episodes, with 2 fatalities and 7 major injuries (19). Details are scant, but at least four occurred at night while the victims were asleep. In one case the bear broke into a camper and pulled the victim out, and in another case the bear entered a wooden teepee (“wickiup”) and dragged the victim out by her foot (29). In most attacks, the black bears were driven away by aggressive actions by the victims their companions, such as yelling and throwing objects.

POLAR BEARS

Polar bears are distributed in a circumpolar fashion around the Arctic Circle and subsist almost exclusively on a diet of seals (Figure 43-2). These bears feed primarily in winter on ice-covered polar seas. Some southern populations live on land during the summer in a state of waking hibernation and starvation. Polar bear-inflicted injuries are much less frequent than those by grizzly (brown) or black bears, primarily because of their remote and harsh environment with relatively little human intrusion. From 1973 to 1987, three people were injured (one fatally) in Norway (15), and from 1965 to 1985, 20 people were injured (six fatally) by polar bears in Canada (20). The number of injuries would probably be much higher except that most people who are in polar bear habitat are

armed, and in the majority of aggressive encounters the bear is killed before causing human injury.

Polar bear-inflicted injuries have been classified into two general categories. The major one is predation, primarily by subadult and adult males. In these instances, five of the six victims who died were probably killed instantly. The other category is by adult females thought to be defending their young. These episodes are typically brief and nonfatal, which supports the theory that the bear is removing a perceived threat. In more than 90% of the incidences of aggressive encounters with polar bears, an attractant, such as food, garbage, or carcasses, was considered contributory (20).

BEARS ON OTHER CONTINENTS

The available data on attacks by bears on other continents are much less complete than those for North American bears. In Europe, the brown bear has coexisted with humans much longer than those in North America. (In some parts of North America, the brown bear is called a grizzly bear, but they are genetically the same species.) As a result, its behavior is less aggressive and more like that of black bears. Numbers of European brown bears are extremely low, and the animals are highly cryptic and nocturnal and thus are rarely seen or encountered. Human injury by brown bears in Europe today is almost nonexistent.

The brown bears in the former Soviet Union live in vast, relatively undeveloped areas, and appear to have aggressive responses against humans similar to those of North American brown bears. Many human injuries from brown bear attacks, including deaths, may be related to bears injured by sport hunters (4).

The panda bear (*Ailuropoda melanoleuca*), commonly known as the giant panda, lives in the temperate climate of the bamboo jungles distributed along the eastern rim of China's Tibetan Plateau. It is one of the most recognized bears in the world, with a distinctive white and black coloration. It is a relatively poor climber but will climb trees on occasion to avoid danger. During winter months, the panda bear migrates to lower elevations where food remains plentiful, thus avoiding the need to hibernate.

The panda bear is primarily a vegetarian. About 99% of its diet consists of stalks, leaves, and shoots of only two bamboo species (33). The panda has an enlarged wrist bone that serves as an opposable digit, much like a thumb. This evolutionary adaptation enables the panda to efficiently hold and strip bamboo stalks. Since bamboo is a relatively poor quality food, the panda must compensate by eating large amounts. Each day it feeds up to 12 hours. The panda bear is shy and reclusive, representing very little threat to human safety in the wild.

The spectacled bear (*Tremarctos ornatus*) lives in the tropical climates of the Andes Mountains along the northwest border of South America. It is one of the two bear

species that lives below the equator. The spectacled bear has a distinctive white coloration around its eyes. It is an excellent climber and spends most of its time in trees eating fruit. It often builds nests and rests in trees as well. Because its source of nutrition is abundant year round, it does not hibernate. Spectacled bears are relatively small and shy. Encounters are extremely rare and they pose essentially no threat to human safety.

The sloth bear (*Melursus ursinus*) lives in the subtropical forests of Nepal, Bangladesh, Bhutan, India, and Sri Lanka. It has a disheveled appearance because of its long, shaggy fur coat. In some of its range the sloth bear coexists with elephants, wild boars, leopards, tigers, greater one-horned rhinos, and Asiatic black bears.

The sloth bear is a special type of insectivore called myrmecophagous because it feeds primarily on ants and termites. It is uniquely adapted for this feeding behavior. With the loss of its 2 upper incisors, an elongated and raised hard palate, mobile lips, and nearly naked snout, the sloth bear can blow away dust to expose termites and create a strong sucking force to feed. It can dig out insect burrows with its long claws, and its coat protects it from insect stings.

Although the data are limited primarily to anecdotal reports, the sloth bear appears to be the most dangerous bear species in Europe or Asia, next to the Russian brown bear. Approximately one native is seriously injured or killed by a sloth bear in Chitwan National Park in Nepal each year (13). In the remote regions of western Nepal, at least one villager is seriously injured by a sloth bear every other year. Most of these injuries are the result of a close encounter, and the victims receive wounds to the head and neck. No predatory behavior has been reported.

The aggression of the sloth bear is between that of the American black bear and grizzly bear. Sloth bear researchers in Nepal work exclusively while riding elephants because of their concern of attacks from rhinos, sloth bears, and tigers, in that order (23).

Asiatic black bears (*Ursus thibetanus*) occupy the broad-leafed forests throughout a large portion of south Asia, from Pakistan across northern India and into China and Southeast Asia (Figure 43-9). Separate populations also occur in eastern Russia, Korea, Taiwan, and Japan. Some of its range overlaps with brown bears, sloth bears, and sun bears. In some localities the Asiatic black bear is called the “moon bear” or the “white-breasted bear” because of the crescent-shaped white coloration on its chest.

The Asiatic black bear is a dietary generalist and feeds on a wide variety of plants, insects, and animal matter. It is a good climber and often forages and rests in trees. Unlike pandas and spectacled bears, these bears hibernate during the winter months. They are hunted extensively for illegal trade of bear parts. About 1 to 2 people are seriously injured by Asiatic black bears each year.

The sun bear (*Helarctos malayanus*) is the smallest of all bear species, rarely weighing more than 45 kg (100 pounds) (Figure 43-10). It occupies tropical regions in Borneo, Burma, Java, Malaysia, Sumatra, and Thailand. As with the spectacled bear, the

sun bear is equatorial because part of its range extends below the equator. It has a white to cream-colored, horseshoe-shaped marking on its chest, providing its common name. In some localities it is called the honey bear. It has a long slender tongue, an adaptation for getting honey from beehives. Its claws are long and more sharply curved than those of other bears, enabling it to be a proficient tree climber, where it can easily hang upside down from a branch. The sun bear is rarely seen and represents almost no threat to humans.

PREVENTION AND RISK REDUCTION

Much literature about safety in bear country involves attack victims (6,19,20,24,26). Such information is gathered from victims who are generally unfamiliar with bear behavior, and whose interpretations of the events reflect their cultural biases. Also, victims often become instant media celebrities. In several cases the circumstances surrounding the attack changed significantly with each telling, usually reducing the victim's culpability. Because of potential litigation, some victims have told their stories only through an attorney. Caution must be used when compiling and analyzing such "data."

Recommendations for avoiding bear attacks have been drawn primarily from what attack victims did "wrong." Because most people who live, work, and regularly vacation in bear country are never injured, it is equally important to understand what they have done "right." Unlike bear attack victims, these people have successfully navigated grizzly country without being injured. Although this information is not as readily available as attack records, it is critical to our knowledge of grizzly-human interactions.

From 1900 to 1985, 115 human injuries were reported from black, polar, and grizzly bear attacks in Alaska, but only two victims were natives (26). This strongly suggests that the behavior of people is important in determining how to coexist with bears safely. Safety in bear country involves four levels of interaction: (1) avoiding an encounter, (2) reducing the chances of being attacked after an encounter, (3) reducing the severity of injuries received if attacked, and (4) reducing the chances of becoming prey to a bear.

Avoid an Encounter

The actions can significantly reduce the chances of having a close encounter with a bear:

1. Make noise so that the bear knows a person is present. This only requires casual conversation to prevent startling a bear at close range. The voice may have to be amplified somewhat while traveling along a noisy stream or a windy ridge. Foghorns have been used successfully in Alaska; "bear bells" may not be sufficiently loud.

2. Remain alert in bear country and be aware that the terrain and environment may hamper a bear's ability to detect a human by sight, smell, or sound. Likewise, the terrain and environment may also hamper your ability to see or hear a bear before it discovers you. An "upwind bear" is more likely to be surprised by you, as is one in heavy forestation or near loud rushing water, in the rain, or in fog (9). And be very cautious around ripened berry patches, streams with spawning fish, and elk calving grounds. Ravens may indicate carrion and the presence of feeding bears.
3. Always using good judgment to avoid a potentially dangerous situation. If fresh bear signs are seen, such as tracks (Figure 43-11), droppings, fresh tree scratches (Figure 43-12) or a carcass (or even scavenger activity indicating that a carcass may be nearby), consider that a bear is in the vicinity and take an alternate route. If the bear is seen first, slowly and quietly retreat to safety; consider aborting the trip or an alternate route. Do not approach bears, or any wild animals, too closely for a better view or photograph. Bear-bear confrontations demonstrate signs of aggression and annoyance (Figures 43-13 and 43-14). These include standing or turning in profile to appear larger and intimidating, vocal hissing and jaw popping, "yawning", and head swinging (9).

Avoid Provoking an Attack

Again, the best way to avoid bear-inflicted injuries is simply to avoid surprising a bear in a close encounter situation. However, no set of known responses guaranteed to prevent an injury in a close encounter, although the following generalizations may be useful:

1. Allow the bear to know you are human and not a prey species. Step away from any visual obstruction to allow the bear to see you fully. Any attempt to hide at this point will only confuse the bear, which may approach closer to identify you, thus creating an encounter at an even closer distance. It is probably best to talk in a calm voice to allow the bear to identify you as a human.
2. Although remaining calm is difficult, you should not make sudden movements or yell out, particularly with a grizzly bear. The bear may view this as an aggressive action and deal with it by an aggressive response.
3. Do not stare directly at the bear. Look to the side or stand sideways to the bear. Standing your ground is important in determining the bear's response (35). This posture tells the bear you are willing to defend yourself if necessary, and it may prevent further aggressive behavior.
4. Do not consider climbing a tree or running away. Not only is it impossible to outrun a bear, running may also prevent the bear from correctly identifying a human and may initiate a charge. Once a bear charges, you cannot locate a climbable tree and

achieve a safe height. Attempting to climb a tree may also prevent the bear from correctly identifying you as a human. Therefore, the best defense during a charge is to stand quietly and non aggressively, and allow the bear to identify you as human and not a prey species.

In most cases, the bear aborts the charge after a close encounter without making contact or causing injury. At this point you should also leave the area, retreating opposite to the direction taken by the bear. If a bear continues to charge, however, resulting in physical contact, your actions should depend on the species, and information from bear attack victims is useful.

Reducing Severity and Extent of Injuries

If attacked by a bear, a victim can take several important steps to minimize injury. The actions taken immediately before, during, and after an attack will influence the type and severity of the injuries.

Humans are rarely killed during an attack precipitated by a surprise close encounter, even though bears can do so easily and quickly. During these attacks, grizzlies are only trying to remove what they perceive as a threat, and their intent is to use only as much force as necessary. When interacting with others of their species, grizzly bears are head oriented, and they usually direct their aggression toward humans in the same manner—toward the head and neck. Therefore the general rules to follow during an attack are to “help” the bear remove the perceived threat and to protect vital body parts, as follows:

1. Do not run, try to climb a tree, fight, or scream.
2. Drop to the ground and protect the head and neck by interlocking the hands behind the head (ear level) and flexing the head forward, either in the fetal position or flat on the ground face down (Figures 43-15 and 43-16). Use elbows to cover the face if the bear turns you over.
3. Do not hold out a forearm or hand to ward off the attack. Bears can readily cause significant neurovascular injuries to these structures.
4. Never try to look at the bear during an attack because it could expose you to potentially serious facial injuries.
5. After the attack, stay down until you are sure the bear has completely left the area. This is extremely important. Victims who have gotten up before the bear has left after the first attack generally received more severe injuries during the second one.

6. When you believe the bear has left the area, peek around while moving as little as possible, try to determine which way the bear went, evaluate options, and then leave the area.

Victims attacked from a close encounter situation who immediately protected themselves and did not try to resist typically received minor injuries treated on an outpatient basis. Victims who tried to run or fight the bear and those who left after the initial attack but before the bear had left the area typically received more severe injuries that required multiple surgical procedures, resulting in permanent cosmetic or functional disabilities.

If the attack is by a black bear, a different set of guidelines should be followed. Black bear aggression should be countered with aggression such as shouting, yelling, throwing rocks or sticks, or whatever means are available. The victim should never lie down in a protective, submissive position because black bears are more likely to prey on humans they encounter at close range than are grizzly bears.

The data on polar bears are less complete but suggest that attacks by females with offspring are behavioral responses similar to those of grizzly females with offspring. The attacks are defensive, brief, and result in non-lethal injuries. In addition, the bear typically leaves shortly after the incident. If a polar bear is alone, however, a person should assume it is a male, whose behavioral response is predation, and should use any aggressive response available.

Prevent Predatory Behavior

The most important means of reducing the chance of being preyed on by a bear is to avoid anything that may attract a bear to the campsite while the occupants are sleeping, as follows:

1. Avoid camping along bear travel corridors or at seasonal feeding sites.
2. Avoid campsites littered with human refuse.
3. Use proper food storage to render human food unavailable to bears. Bear-resistant food storage containers are often provided at designated campsites in bear country (Figure 43-17).
4. Reduce food odors by cooking and eating at a site different from the sleeping area. Do not sleep in clothes worn when cooking and eating.
5. Do not leave garbage or food buried or poured into the ground at the campsite. This can cause problems for future campers at this site.

The chance of a bear entering a campsite to prey on humans is small, but everyone in the camp should be familiar with a contingency plan. Everyone should know the area, even in the dark, and be aware of potential escape options, such as climbable trees or rocky ledges. Everyone should sleep in a tent because it offers a boundary of protection and may deter an inquisitive bear from walking directly to the campers. Although no study has proved its effectiveness, some people build a brush barrier around the tent to prevent a bear from readily approaching it.

Sleeping bags should be kept at least partially unzipped to facilitate a quick exit. In several instances a victim trapped inside a sleeping bag has been dragged away from a campsite by a bear.

Each tent should be equipped with a flashlight. Pepper spray is useful, as well as a firearm, unless prohibited in that area. Again, a bear that enters a tent or picks up a sleeping camper is trying to prey on that person, so all available defenses should be used.

The behavior of a predatory bear is different than that of a bear responding to a close encounter. During a close encounter a bear's response is driven by a defensive reaction, which can be aggressive and injurious. In contrast, the behavior of a predatory bear is driven by the desire for food. The bear is not looking for a confrontation or fight but rather a victim to drag from camp, usually only a few hundred feet, and consume. Predatory grizzly and black bears rarely kill their victims before consuming them. They concentrate on soft tissue or visceral consumption, and the victims frequently remain alive for an hour or more. Therefore a quick, aggressive, and unified response by companions may save the victim's life. Surprisingly, yelling, throwing rocks, or striking the bear with a stick has been effective in driving the bear away from its victim. Approaching a predatory bear in the dark while it is feeding on a human is risky, but probably the victim's only chance for survival.

In contrast, the victim of a predatory attack by a polar bear is typically killed instantaneously, so prevention of such attacks is the only chance for survival. In all predatory attacks by polar bears, all defensive measures must be considered, including guns where permitted.

SPECIAL CONSIDERATIONS

Menstruation. In August 1967, two women were killed in separate events on the same night by different grizzly bears in Glacier National Park. The postmortem examination showed that one had been menstruating. The assumption that menstruation may be a precipitating factor in bear attacks has unfortunately become solidly ingrained into popular opinion. Hysterical coverage by the mass media enhanced this misconception, and the scientific question was left unanswered by both scientists and government officials (2).

A study of polar bear response to menstrual odors was published in 1985 (7). Although it was not designed to adequately test the hypothesis that menstruating women were more likely to be either attacked or preyed on by bears, the press came to this conclusion. The Interagency Grizzly Bear Committee then printed an ambivalent caution in the government's official grizzly bear pamphlet (*Bear Us In Mind*) that said, "Women may choose to stay out of bear country during their menstrual period." Fortunately, this has since been removed from the pamphlet, because no scientific evidence suggests that menstrual odors precipitate grizzly bear attacks. The attack mentioned previously is the only serious attack on a menstruating woman that has been documented in North America, and even the official investigating team at that time concluded that menstruation did not appear to have played a major role (19).

Black bear researchers in North America report no evidence of black bears attacking or being attracted to menstruating women (31). Furthermore, no evidence links menstruation to any of the 21 grizzly bear attacks in Yellowstone National Park from 1980 to 1994 (18).

Sexual Activity. A common concern among backcountry users is that sexual activity may attract bears and make them more aggressive towards campers. As with menstruation, these fears are based on hysteria and folklore. No anecdotal or scientific evidence supports this hypothesis.

Pepper Spray. Based on a concern for protection against aggressive bears, several methods were investigated for backcountry users. In the late 1970s and early 1980s, several compounds were tested if for effectiveness in deterring grizzly bear attacks. The most effective method was an aerosol spray containing capsicum oleoresin, a derivative of red pepper. Captive grizzly bears sprayed in the face at close range when they charged the researchers outside the cage. Under these controlled conditions, red pepper spray was found to be highly effective in deterring a charging grizzly bear.

Pepper spray (5% to 10%) is commercially available as personal protection against aggressive animals. The effectiveness of pepper spray used in the field against aggressive bears has been difficult to assess. It has been used in too few cases to draw firm conclusions. Also, it is impossible to conduct scientific studies testing the effectiveness of pepper spray used in field conditions.

By 1985, pepper spray was used in the field against aggressive black and grizzly bears in 66 documented cases (21). In general, it appeared more effective in deterring bears that charged after a close encounter than against food-conditioned bears in search of food. During the 1990s, however, most professional outfitters and guides in the northern Rocky Mountains began carrying pepper spray to deter aggressive grizzly bears, preferring spray over firearms. Although data are limited to anecdotal reports, pepper spray can be an effective and non-lethal alternative to repel aggressive grizzly bears, perhaps even more effective than firearms.

Carrying pepper spray, however, is not a substitute for knowledge of bear safety and good judgement to avoid aggressive encounters. If carried, spray must always be readily available, either in a belt-mounted holster or on a chest strap. It should be test-fired, and the user should practice drawing and firing it regularly (Figure 43-18).

Despite a manufacturer's claim that pepper spray has an effective range of 9 m (30 feet), the effective range under field conditions is significantly less due to either head winds or cross winds. Preliminary field experience indicates that the oil-based pepper spray is more effective than water-based spray. I recommend a pepper spray that contains 10% oleoresin capsicum, has 2 million Scoville heat units, and comes in a 15 ounce pressurized aerosol container.

Unfortunately, people have used pepper spray similar to mosquito spray. Despite its obnoxious and caustic smell, some people actually sprayed it on themselves, as well as their tent, their sleeping bags, and even the ground around their campsite. Once the aerosol has been released, the capsicum begins to lose its potency, and soon the active ingredient dissipates. At this point, bears may investigate the smell of pepper. Pepper spray so used thus becomes a bear attractant rather than a deterrent. One manufacturer of pepper spray (UDAP Industries, www.udap.com) provides a detailed instructional pamphlet on its proper use.

Pepper spray should be aimed towards a charging bear and discharged when the bear is within 6 to 9 m (20 to 30 feet). The person should continue spraying until the bear has stopped its charge, keeping the sprayer aimed at the bear in case it charges again. This continues until the bear has left the area. If the pepper spray is depleted, the best defense if the bear attacks is to lie down, cover your face, and offer little or no resistance. Again, there is no guarantee that pepper spray (or anything) will prevent injury by an aggressive bear.

If pepper spray is accidentally discharged into a person's face, it stimulates facial nociceptors and causes eyelid, ocular, and facial muscle spasms, which may result in temporary blindness. The victim should not rub the eyes (to avoid corneal abrasions) and should irrigate the eyes and skin vigorously with water for at least 25 minutes. Intraoral burning may be relieved by swishing and spitting milk or another casein-containing food product (9).

Firearms. Many people consider carrying a firearm for protection when they enter bear country. Guns can be useful in some situations. However, the target area to kill a grizzly with a shot to the head is only about 30 cm² (12 square inches). The cranial vault is narrow and sloped caudally (Figure 43-19). A bear initiating a charge from about 45 to 55 m (50 to 60 yards) will take only 4 to 5 seconds to reach its victim.

Unless a proficient marksman, a person is unlikely to access a weapon, release the safety, aim accurately, fire, and hit such a small target in a brief time under incredible emotional stress. Also, even if a shot could be fired, it probably only wound the bear.

Wounding a charging bear changes its behavior and may make its attack even more aggressive. Because of these factors, pepper spray should be considered as a non-lethal alternative to guns, especially when traveling in places where guns are not permitted, such as national parks.

According to most U.S. and Canada wildlife agencies, the most effective firearms against grizzly bear attacks are a 12-gauge 3-inch magnum shotgun with 1-ounce slugs and a 30-06 rifle with a 200-grain bullet. A pistol is not considered to be an effective weapon against a charging grizzly. A large caliber pistol, such as a 44-caliber magnum, can be used as a point blank weapon to kill a bear attempting to prey. The effective accurate range of a pistol and pepper spray is about the same distance, but it is easier to hit a moving target with pepper spray because of its shotgun-like aerosol pattern.

Dogs. In most national parks, it is a moot point since dogs are not permitted in backcountry settings. Unfortunately rare and questionably accounts report a dog stirring up a grizzly, then running back to its owner with the bear in pursuit. Most outfitters, guides, and hunters, however, report positive experiences with dogs in grizzly country. Their dogs are generally well trained and have been raised in wilderness environments. Most of these dogs can effectively deter grizzly and black bears from coming into a camp. Although no study has been conducted on the use of dogs to deter aggressive bears, most people who spend a considerable time in grizzly country use their dogs for this purpose.

Horses. For individuals concerned about an aggressive bear encounter, another option is the use of horses. No one has been injured by a grizzly or black bear while riding a horse. Horses that frequently travel in bear country are the best to use, since they don't generally react unpredictably and endanger the rider when they encounter bears. Although horses may protect against aggressive grizzly encounters, riders still may be injured by the horse. People are seriously injured or killed in horse accidents each year in the northern Rocky Mountains.

Hunter Safety. Many people participate in sport hunting in bear country each year. Some are hunting for bears, but most are hunting for other game species.

For hunters of bears, the risks are obvious. Bear hunters intentionally break bear safety rules to get close to their prey. The most dangerous situation, however, is after they shoot and injure a bear. They have an ethical obligation to track the wounded animal and kill it, but this is when most bear hunters get injured. This confirms that guns are not completely effective in preventing bear injury. An injured bear may take refuge in heavy cover, then charge when the hunter is at close range. With little time, a surprised hunter often cannot fire a lethal round, and even when shot, the bear can continue its attack and cause significant injury before it dies.

Hunters of other game species in bear country are at significant risk of close encounter and injury. Besides violating bear safety rules, they frequently become preoccupied with the stalk and forget they may encounter a bear. During the 1990s, more

than half the people injured by grizzly bears in the Yellowstone Ecosystem have been elk hunters. Some injuries occurred during the stalk, but other factors contributed. Grizzly bears in this ecosystem have learned the association between gunfire and available food. After an elk or other big game (moose, deer, and bighorn sheep) has been killed, hunters field-dress their kills and leave edible remains (gut piles) on the ground. In several cases, bears approached the kill site before the hunters completed this process. In other cases, an elk or animal was field-dressed late in the evening, then hung in a nearby tree. When the hunters returned the next morning, they encountered a grizzly that had claimed the gut pile or the carcass. Hunters must assume that under these circumstances, at least one grizzly bear will be at the site, and they must approach cautiously, preferably on horseback.

Bow hunting represents another high-risk activity. In most states, bow hunters are not allowed to carry a firearm as a backup weapon. They also tend to violate bear safety rules to set up a shot. Elk hunters blow an artificial elk call (a bugle) to lure in bull elk. This also alerts grizzly bears that prey on adult male elk (bulls) during the breeding season. For protection, bow hunters should (1) hunt from a tree-stand, which provides some protection from grizzly bears, who are poor tree climbers, and (2) carry pepper spray and be prepared to use it.

BEAR-INDUCED INJURIES

Bear-inflicted injuries range from minor, treated on an outpatient basis, to complex, requiring hospitalization and surgery, typically resulting in significant cosmetic and functional disability. In this regard, bear attacks are similar to most other animal attacks, particularly those inflicted by large animals.

The character of such injuries is determined in part by the three main sources: teeth, claws, and paws. The teeth of bears, especially the canines, are large and sturdy. Although the teeth are not particularly sharp, the power of the jaw muscles allows the teeth to penetrate deep into soft tissues and to fracture facial bones and bones of the hand and forearm with ease. The trauma characteristically results from punctures, with shearing, tearing, and crushing forces (Figure 43-20).

The claws are another important source of trauma. Although the claws on the front pads can be as long as human fingers, they are not particularly sharp on grizzlies and polar bears. The bear's shoulders, however, provide the force and speed that allows claws to cause significant soft tissue damage in a scraping maneuver that results in deep, parallel gashes. Because black bear claws are sharper and more curved, the cuts tend to have sharper, less ragged edges.

The bear paw is capable of delivering a powerful force, resulting in significant blunt trauma, particularly to the head and neck, ribcage, and abdominal cavity, especially solid organ rupture. Therefore victims of bear attacks should be evaluated for occult blunt trauma.

Several victims of a bear attack were further injured when a companion accidentally shot them while trying to kill the attacking bear. Others were injured when they fell out of a tree while escaping a bear; some sustained long bone fractures. At least two people in North America have been killed by such falls, and in both incidents the bear did not attack the victims once they fell to the ground.

WOUND MANAGEMENT

The specifics of initial wound treatment are determined in part by the available medical equipment and location in which the victim is first received. Stabilization of the victim remains the primary objective. All victims of bear attacks should be considered to have major trauma and should be transported to the most appropriate facility after stabilization.

By the time most bear attack victims reach medical care, their injuries are relatively “old”. Bear-inflicted injuries are often occult, producing greater tissue necrosis than initially expected. Deep structure involvement is typically more prevalent than is initially apparent. Internal injuries from either direct penetration (claws, teeth) or blunt trauma are common. Neurovascular injuries must be considered with trauma to the extremities, and neurosensory and cosmetic injuries are common with trauma to the face.

ANTIBIOTICS

Little information is available about the organisms in bear-inflicted wounds, but anecdotal evidence suggests that bear attack victims do not develop unusual or rare septic complications from unknown pathogens. In one study, cultures of the mouths of black bears revealed a bacterial spectrum similar to that in dogs, with the majority of species being *Micrococcus* and *Streptococcus* (10). *Staphylococcus aureus* was found in only 8%, and *Pasteurella* and *Eikenella* were not found. In a similar study of the bacterial flora in the oral cavities of grizzly bears, *Escherichia coli* was found in 98% of the samples taken (12).

The use of antibiotics shortly after the injury but before clinical evidence of infection remains controversial. The usual risk factors should be assessed, (Table 43-2) (3). However, the blunt trauma, deep punctures, and shearing-tearing forces that are typical of bear attacks create significant tissue ischemia and necrosis that are not apparent on the initial examination. Therefore anti-microbial prophylaxis should be considered for all bear-inflicted wounds pending culture results and before clinical evidence of infection.

Before culture results are available, penicillin is suggested for relatively clean superficial injuries. A third-generation cephalosporin should be added to cover gram-negative organisms for deeper and more contaminated wounds (10). However, adequate wound debridement and cleansing are the primary means of reducing the infection rate

among these victims. Antibiotics should be administered parenterally for at least 3 days after wounding and at least 2 days after each debridement (9).

RABIES

No case of rabies has been reported or documented in either wild or captive bears. The Centers for Disease Control and Prevention (CDC), however, recommends rabies immunization for victims attacked by wild carnivores. Therefore all victims of bear attacks should receive the standard informed-consent discussion of the risks and benefits of rabies immunization.

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TABLE 43-1

DISTRIBUTION of the EXTANT BEAR SPECIES

Common Name	Scientific Name	Distribution
Panda Bear	<i>Ailuropoda melanoleuca</i>	Eastern rim of China's Tibetan Plateau
Spectacled Bear	<i>Tremarctos ornatus</i>	Andes Mountains in South America
Sloth Bear India, Sri	<i>Melursus ursinus</i>	Nepal, Bangladesh, Bhutan, northern Lanka
Asiatic Black Bear northern India separate Korea,	<i>Ursus thibetanus</i>	Southern Asia from Pakistan across and into China and southeast Asia; populations also occur in eastern Russia, Taiwan, and Japan
Sun Bear Thailand	<i>Helarctos malayanus</i>	Borneo, Burma, Java, Malaysia, Sumatra,
American Black Bear most of the lower 48 states		<i>Ursus americanus</i> Alaska, Canada, and
Brown Bear Canada, and (including Washington)	<i>Ursus arctos</i>	Throughout much of Eurasia, Alaska, the northern Rocky Mountain states Wyoming, Montana, Idaho, and
Polar Bear	<i>Ursus maritimus</i>	Arctic circle (circumpolar)

TABLE 43-2**ANIMAL BITE RISK FACTORS****HIGH RISK**

Location:

Hand, wrist, or foot
 Scalp or face in infants
 Over a major joint
 Through and through bite of cheek

Type of wound:

Punctures
 cleaned
 Tissue crushing that can't be debrided
 abrasions
 Bites over vital structures (artery, nerve, etc)

Patient:

Older than 50 years
 Asplenic
 Chronic alcoholic
 Altered immune status
 Diabetic
 Peripheral vascular insufficiency
 Chronic corticosteroid therapy
 Prosthetic or diseased cardiac valve
 Prosthetic or seriously diseased joint

LOW RISK

Location:

Face, scalp, ears, and mouth
 Self-bite of buccal mucosa

Type of wound:

Large clean lacerations that can be
 Partial-thickness lacerations and

Patient:

Less than 50 years
 Good medical health