



Research Article

Fatal Attacks by American Black Bear on People: 1900–2009

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ABSTRACT At least 63 people were killed in 59 incidents by non-captive black bear (*Ursus americanus*) during 1900–2009. Fatal black bear attacks occurred in Canada and Alaska ($n = 49$) and in the lower 48 states ($n = 14$). There were 3.5 times as many fatal attacks in Canada and Alaska but only 1.75 times as many black bears, and much less human contact for black bears in Canada and Alaska. There was a weak positive correlation ($r_s = 0.56$, $P \leq 0.000$) between the estimated size of a bear population within a given jurisdiction and the number of fatal black bear attacks. Some jurisdictions had no fatal black bear attacks but had large estimated black bear populations. Of fatal attacks, 86% (54 of 63, 1.08/yr) occurred between 1960 and 2009. There was positive linear relationship between the number of fatal black bear attacks per decade and human population size in the United States and Canada per decade ($r^2 = 0.92$, $\beta = 0.000$, $P \leq 0.001$). Of fatal attacks, 91% (49 of 54) occurred on parties of 1 or 2 persons. In 38% (15 of 40) of incidents, peoples' food or garbage probably influenced the bear being in the attack location. We judged that the bear involved acted as a predator in 88% (49 of 56) of fatal incidents. Adult ($n = 23$) or subadult ($n = 10$) male bears were involved in 92% (33 of 36) of fatal predatory incidents, reflecting biological and behavioral differences between male and female bears. That most fatal black bear attacks were predatory and were carried out by 1 bear shows that females with young are not the most dangerous black bears. As a result of our research agencies managing black bear can more accurately understand the risk of being killed by a black bear, and can communicate this to the public. With training, people can learn to recognize the behaviors of a bear considering them as prey and can act to deter predation. © 2011 The Wildlife Society.

KEY WORDS American black bear, fatal bear attacks, *Ursus americanus*, predation on humans, human–black bear conflict.

Although American black bear (*Ursus americanus*) are members of the order Carnivora, they are largely omnivorous (Pelton 2003). Black bear have compact and strong muscles and can run fast for short distances. Their jaws, teeth, forearms, and claws can inflict serious injury to other bears and animals, including people. Aggression and social interaction are components of determining dominance related to occupying space, feeding, and mating. Most individual black bear have the strength to overcome an unarmed person. However, observations of aggressive black bear–black bear and black bear–human interactions have shown that physical contact is a minor component of aggressive interactions (Jordan 1976, Eager and Pelton 1979, Herrero 1985). Black bear are opportunistic predators but in most populations diet is primarily derived from plants and insects (Pelton 2003).

Black bear are a biologically successful, widely distributed species, found from northern Mexico to, and occasionally

beyond, the northern limit of trees in Canada and Alaska. A population estimate for the early 2000s, based on correspondence with most jurisdictions where black bear are found, estimated 750,235–917,650 black bears in North America (Hristienko and McDonald 2007). During the 1980s and 1990s most black bear populations grew numerically and geographically (Williamson 2002). In the United States and Canada, 60% of states and provinces reported increasing populations, and all other populations appeared to be either stable or fluctuating with no clear trend (Garshelis and Hristienko 2006). Between 1988 and 2001 black bear numbers in Canada and the United States were estimated to have increased between 17.6% and 19.8% (Garshelis and Hristienko 2006). Black bear numbers and their wide distribution lead to extensive contact with another widely distributed, numerically successful mammal, human beings.

Black bear are often drawn into conflict situations with humans after being attracted by peoples' food or edible garbage (Eager and Pelton 1979, Herrero 1985). Defensive threat behavior is common when a person or other bear comes within the bear's overt reaction distance (Herrero et al. 2005:363). When this occurs black bear behave as

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if they were stressed. If bears do not flee they usually direct threats at the intruder. Black bear threats may include physical behaviors such as swatting the ground with one or both front paws, short charges (i.e., running toward) but stopping short of contact, slow and deliberate approaches, and clacking of the teeth by bringing the upper and lower jaws together (Eager and Pelton 1979, Herrero 1983). These displays may be directed at other bears or people. Sounds emitted by a black bear are also a component of threat behavior. These have been described as huffing, snorting, gurgling, and loud growling (Jordan 1976, Eager and Pelton 1979, Herrero 1983). Threat behaviors seldom lead to physical attack by a black bear provided the bear is given the personal space it requires to feel secure. Most fatal attacks by black bear on people have been judged as predatory (Whitlock 1950; Herrero 1985; Herrero 2002; Herrero and Higgins 1995). Bears did not typically display physical or vocal defensive threat behaviors during predatory attacks (Herrero 1985, 2002; Herrero and Higgins 1995). Behavioral components such as stalking (i.e., searching); full out attack typically using paws, claws, jaws, and teeth, consuming a person's flesh; and dragging, guarding, and burying a body support the classification of predation (Herrero and Higgins 2003).

In 1948 a young girl was killed in a predatory attack by a black bear near Sault Saint Marie, Michigan. This became the first fatal black bear attack to be assessed in the scientific literature (Whitlock 1950). Since then serious and fatal black bear-inflicted injuries have been studied as part of analyzing bear attacks in several jurisdictions (Middaugh 1987; Gunther 1994; Gniadek and Kendall 1998; Herrero and Higgins 1998, 1999, 2003; Miller and Tutterow 1998).

Each year in North America there are human injuries inflicted by black bear. The worst of these, fatal attacks, can be minimized by understanding the circumstances associated with such attacks. Without this knowledge, fear and supposition may play an undeserved role in assessing the danger posed by black bear. Peoples' acceptance of some probability of black bear-inflicted injury, even fatal injury, is essential for bear conservation. At the same time the public must trust that bear managers have vigorously tried to reduce chances of serious injury through studying and understanding attacks and sharing this information with the public. Accurate data regarding risk of fatal attacks by black bear may influence risk perceptions and generate public support for bear management and conservation (Knuth et al. 1992, Gore et al. 2007).

Our objectives were to: 1) locate, categorize, and analyze accurate records of all fatal attacks by American black bear in the United States and Canada, 1900–2009, and 2) synthesize implications for management, including how fatal attacks may be avoided. We focused on fatal attacks because these are the most extreme and undesirable encounter between a human and a black bear and also because detailed investigations are usually conducted for fatalities. We considered bear and human-related variables associated with fatal attacks, defined and described below, and trends in fatal attacks over time.

STUDY AREA

Our study area was the United States, and Provinces and Territories of Canada that had black bear populations anytime between 1900 and 2009. Although black bear are found in northern Mexico we did not search for records of fatal black bear attacks there because discussion with persons knowledgeable about black bears in Mexico did not identify any fatal attacks (D. Doan-Crider, Comfort, Texas, personal communication). For some analyses we grouped fatal attacks into categories of those occurring in Canada and Alaska versus the lower 48 States because there are more black bears and fewer people in Canada and Alaska as compared to the lower 48 States.

METHODS

The first author began a database with details regarding injuries inflicted by American black bear or brown (grizzly) bear (*Ursus arctos*) in 1967 (Herrero 1970, 1985, 2002). This database is now in File Maker Pro™ (File Maker Pro, Santa Clara, CA), Our current analysis focuses on fatal injuries inflicted by black bear, 1900–2009. During the 1990s we contacted all of the States (U. S.), provinces and territories (Canada), and national parks that had populations of black bear anytime during the study period. We requested records of fatal bear attacks that had occurred since 1900 and sought missing details by correspondence or phone. We also searched published literature, both scientific and popular, as well as newspapers that were electronically accessible. When possible we used records provided by park, state, province, or territorial wildlife management agencies. Otherwise, we used what seemed to be the most reliable sources of information available. Since 2000 we have used various computer search engines to find basic information regarding fatal attacks; since 2006 we have exclusively used Google™ (Google Inc., Mountain View, CA) to assist our searching. After a search engine identified a possible fatal attack we then contacted relevant agencies for confirmation and details.

Some fatal attacks that occurred during the early decades of the 20th century may not have been reported and thus may not be included in our study; however because of the nature of information sources we used we think few such incidents exist. Inaccuracies or assumptions may have been reported regarding the details of some incidents, however we designed our data collecting methods to minimize inaccuracies. For our database, we used and tried to corroborate multiple sources of information about fatal attacks. When in doubt regarding some piece of information for a specific incident we left the data field blank. Depending upon the variable under study and the insights we wanted to develop, we present our results either in terms of the number of people killed or the number of incidents in which people were killed.

Data details for some variables associated with fatal attacks were not available. In such situations we report the number of fatal attacks or incidents for which we do have data. For

example, regarding the attacking black bear's apparent health, we had data for 34 incidents. We represent the numbers of times an apparent health problem was identified as 32% (11 of 34). This means we only had data for this variable for 34 incidents, and for 11 of these the bear had a wildlife management agency described apparent health problem, such as very low body weight, or significant injury. We may also have underestimated the number of predatory attacks because data required to meet our definition of predation were not always available. We only included incidents where the black bear fatally attacked a person. We did not include an incident where a boy died of respiratory problems after fleeing from a black bear (Antonio Hansell, New Hampshire, 3 August 2004) because the boy did not die as a result of physical attack by a bear. Nor did we include 2 other fatalities where a bear was involved but did not directly cause the person's death (F. Beals, Maine, 1910; and M. Wiig, British Columbia, 1966). We did include an incident where a black bear chased a boy up a tree, injured him, and was responsible for the boy falling and dying (M. Patterson, Porcupine Mountains State Park, Michigan, 19 June 1978). Here physical injury by a bear led to death. Also, we did not include incidents where a captive black bear killed a person.

To reduce subjective interpretation of incidents, we relied on as rigorous definitions as possible of classification terms. Some of these terms were defined in previous publications (Herrero and Higgins 2003). Our classification terms and definitions follow. 1) *Predation*: a series of behaviors, including searching, following or testing, attacking (capturing), killing, sometimes dragging a person, sometimes burying them, and often feeding upon them (to be classified as predation in our study, killing and some related behaviors had to be reported); vocalizing and stress behaviors by the bear were usually absent; 2) *Attempted predation*: behaviors associated with predation occurred but killing did not; 3) *Predatory attacks*: incidents that involved predation or attempted predation; 4) *Front-country*: locations within 2 km of traveled roads (i.e., paved roads or a high-speed gravel roads that had regular vehicle traffic), including auto access campgrounds, landfills, picnic areas, and rural home sites and also including the portion of hiking trails within 2 km of traveled roads; 5) *Back-country*: locations >2 km from traveled roads, including trails, backcountry lodges, backcountry cabins, and backcountry campsites; and 6) *Peoples' food or garbage*: peoples' unsecured food or edible garbage. We considered peoples' food or garbage to have influenced an attack when the food or garbage was within 100 m of the attack site and if the black bear had some behavior directed toward exploring or consuming people's food or edible garbage.

We used Spearman's rank correlation to test for a correlation between black bear estimated population size in each jurisdiction during the early 2000s and the total number of fatal attacks per jurisdiction (Hristienko and McDonald 2007). We used linear regression to quantify the relationship between human population size in the United States and Canada per decade and the number of fatal black bear attacks per decade. We determined significance at the

$\alpha = 0.05$ level for all statistical tests. We conducted all statistical tests in SAS 9.1 (SAS Institute Inc., Cary, NC). Decade data for the United States population 1900–1999 came from Demographia and the Public Purpose (2010). Data for the US population through 2009 came from Information Please (2010). All data for Canada's population came from Wikimedia Foundation Inc. (2010).

RESULTS

We determined 63 people were killed in 59 incidents by a non-captive black bear during 1900–2009 (Table S1, available online at www.onlinelibrary.wiley.com). Of the fatal attacks 49 occurred in Canada and Alaska and 14 occurred in the lower 48 states (Fig. 1). There were 3.5 times as many fatal attacks in Canada and Alaska, but there were only 1.75 times as many black bears and much less human contact (due to fewer people in black bear habitat) for black bears in Canada and Alaska. There was a weak positive correlation ($r_s = 0.56$, $P \leq 0.000$ between the estimated size of a bear population within a given jurisdiction and the number of fatal black bear attacks. Some areas had no fatal black bear attacks but in the early 2000s had numerically large estimated black bear populations (i.e., CA: 31,000 black bears; ID: 22,500 black bears; ME: 23,000 black bears; MT 20,000 black bears; and OR: 27,500 black bears; Hristienko and McDonald 2006).

Along with increases in black bear and human populations, fatal attacks per decade increased over time (Fig. 2). Of the fatal attacks, 86% ($n = 54$: 1.08/yr) occurred between 1960 and 2009. There was a positive linear relationship between the number of fatal black bear attacks per decade and human population size in the United States and Canada per decade ($r^2 = 0.92$, $\beta = 0.000$, $P \leq 0.001$; Fig. 3). Fatal attacks



Figure 1. Locations and numbers of American black bear-inflicted human fatalities, Canada and United States, 1900–2009.

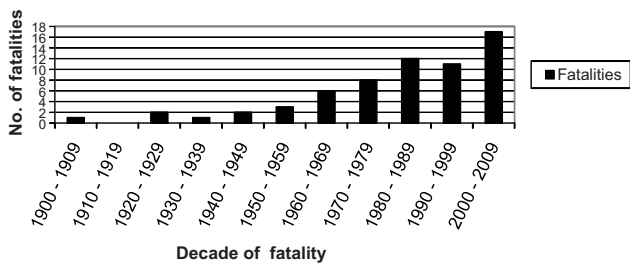


Figure 2. Fatal American black bear attacks by decade, Canada and United States, 1900–2009.

occurred between April and November, with 85% (52 of 61) occurring between May and September (Fig. 4). Most fatal attacks (70%, 30 of 43) took place during daytime (0600 hours through 1759 hours), whereas 19% (8 of 43) occurred during evening (1800 hours through 2359 hours) and 12% (5 of 43) occurred at night (2400 hours through 0559 hours). Fatal attacks occurred in both back-country (61%, 30 of 49) and front-country locations (39%, 19 of 49). In 87% of incidents (7 of 8) the attack persisted for between 10 min and several hours. There was only 1 incident <2 min.

Of fatal attacks, 91% (49 of 54) were on parties of 1 or 2 persons (Fig. 5) and 69% (37 of 54) were on parties of 1 person. In most cases, only 1 person was killed during a fatal attack, however, in 3 incidents 2 or 3 people were killed by the same bear within several hours. In 1 incident a black bear killed a person one day and then a few days later attempted to kill another person. In 95% (19 of 20) of incidents, surviving people in the party reported not sensing the bear until it was <50 m distant. Humans of various ages and sexes were killed (Fig. 6). People killed were participating in a variety of activities prior to being attacked (Table 1). Our impression is that any activity that brings people and black bear into possible close proximity may very rarely be associated with fatal attack. Bear cayenne pepper spray was not used for defence during any of the fatal attacks.

There were no incidents in which there was clear evidence that >1 bear was known to have been involved in the fatal

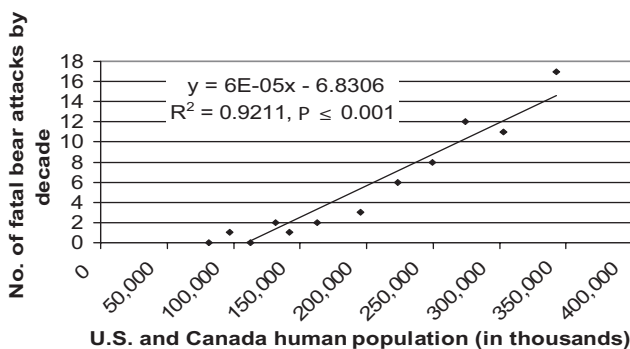


Figure 3. Simple linear regression of the number of fatal black bear attacks in the United States and Canada in each decade, 1900–2009, and the combined United States and Canada human population in each decade. Each data point represents a decade and human population increased with each decade.

attack. Based on strict criteria as described in our methods, we judged that the bear involved acted as a predator in 88% (49 of 56) of incidents. Adult ($n = 23$) or subadult (i.e., weaned from mother but not yet breeding; $n = 10$) male bears were involved in 92% (33 of 36) of predatory fatal incidents. In 8% (3 of 36) of fatal incidents an adult female bear with young inflicted the fatality. No incidents were attributed to a single adult female or subadult female bear. In 68% (23 of 34) of incidents the bear was reported to have been healthy. In 32% (11 of 34) an apparent health problem (e.g., underweight, injured, poor condition) was identified by agency personnel. Rabies was never identified in a bear causing fatal injury.

In 38% (15 of 40) of incidents peoples' food or edible garbage probably influenced the bear being in the attack location, as in these incidents the bear was known to have either fed on food or garbage or showed exploratory behavior directed toward food or garbage that was within 100 m of the attack site. There were no incidents in which a black bear attacked a person in apparent defence of an ungulate or other carcass, nor were there any incidents in which a black bear attacked and killed a person while trying to claim an ungulate carcass. There was 1 fatality where a hunter wounded a bear, which then attacked and killed the hunter. There were 2 separate incidents where a black bear was breaking into a cabin and was shot and wounded by a person in the cabin. In each case the bear attacked and killed the person.

DISCUSSION

Assessed Risk of Fatal Black Bear Attacks

Our research offers important and unique longitudinal insight into fatal black bear attacks on people in Canada and the United States. The risk of fatal black bear attacks on people in our study area was extremely low. Each year, millions of interactions between people and black bears occur without any injury to a person, although by 2 years of age most black bears have the physical capacity to kill a person (Herrero 1985, 2002).

Although the risk of a black bear fatally attacking a person is low, it does exist. The moderately positive correlation between the estimated number of bears in a given jurisdiction and the number of fatal attacks suggests that the number of black bears in an area may be one factor contributing to chances of fatal attack. However, 5 states had black bear population estimates of $\geq 20,000$, yet no fatal attacks. The widespread geographic distribution of fatal attacks suggests that they may occur in a variety of bear habitats and bear population conditions. Fatal attacks do not appear to be associated only with a specific black bear population, geographic area, or habitat. Fatal attacks were most numerous during the month of August, when most black bears are ingesting high-energy foods in preparation for denning. Rarely, a person may be perceived as potential high-energy prey. During August there are also many people pursuing outdoor activities, thus increasing the chances of contact with black bear.

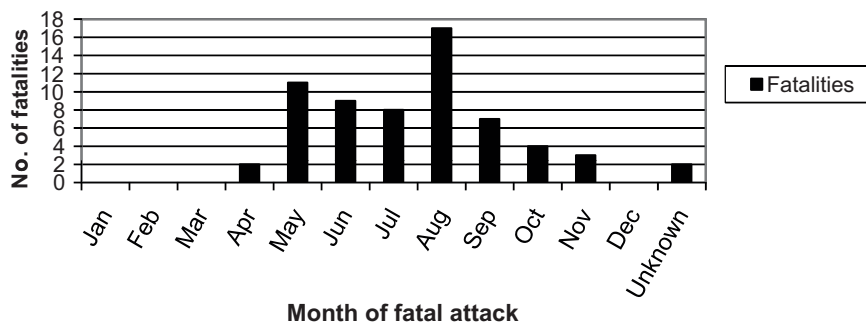


Figure 4. Month of occurrence of fatal American black bear attacks, Canada and United States, 1900–2009.

Understanding and Avoiding Fatal Black Bear Attacks

Our data suggest reasons but do not explain why a greater proportion of fatal black bear attacks occurred in Canada and Alaska versus in the lower 48 states; more empirical research would benefit management. We speculate that many black bears in Canada and Alaska had less contact with people because the human population is about 10% of the population in the lower 48 states. Most black bear populations in Canada had far less hunting pressure (Hristienko and McDonald 2007). Also many black bears in Canada or Alaska existed in less productive and less diverse habitat with periodic food stress, perhaps predisposing some bears to consider people as prey. All, some, or none of the foregoing factors may have contributed to the greater proportion of fatal attacks in Canada and Alaska versus the lower 48 States.

Why have the number of fatal attacks increased over time and in most decades, and why have 86% of all known fatal attacks occurred since 1960? Again, the data do not provide an answer. We speculate that one contributing factor is human population growth and increased recreational and commercial activities of people in black bear habitat since 1960. The human population in Canada and the United States increased by 10.6% from 1989 to 1999 (Demographia and the Public Purpose 2010), whereas the black bear population increased by an estimated 17.6–19.8% from 1988 to 2001 (Garshelis and Hristienko 2006). More people are having more opportunities to interact with black bears, which in itself increases the chances of human–black bear interactions and thus the occasional fatal attack. The positive

linear relationship between the number of fatal black bear attacks per decade and human population size per decade also supports the supposition that fatal bear attacks over time are related to the number of people potentially in bear habitat.

Considering additional dimensions of fatal black bear attacks on people over the past 110 years offers understanding and insight for multiple avoidance strategies. First, the number of people in parties where a person was fatally attacked suggests that parties of 1 or 2 people are more likely to be fatally attacked than are larger parties. Also contributing to the high representation of groups of 1 or 2 people might be that larger groups are less frequent. We have no data regarding the frequency of groups of different sizes in different areas. Also numerically larger parties are probably louder and more intimidating and better able to fight off a black bear attack. Second, people of all ages and sexes were victims of fatal attacks showing that fatal attacks do not favor young, small, or older people. Because we do not know the exposure rate to bears for different age cohorts of people we cannot tell if bears are more likely to fatally attack a specific age group. Our impression from our data is that young and older people may be more vulnerable to fatal attack because they may be perceived as less threatening and may be less able to resist serious attack.

Third, no specific activity by a person, beyond being in bear habitat and near the attacking bear, was associated with fatal injuries. Most bears involved in fatal attacks were not known to have had a history of association with people. Because fatal attacks took place in both front- and back-country locations

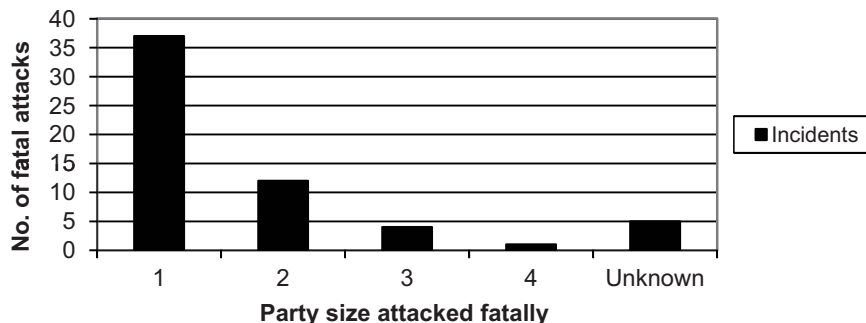


Figure 5. Party size and number of fatal American black bear attacks, Canada and United States, 1900–2009.



Figure 6. Age and sex of people killed by American black bear, Canada and United States, 1900–2009.

we believe that some attacking bears had prior experience with humans and others did not.

Fourth, no one who was killed by a black bear had bear spray. Nor was bear spray available for other party members to deter the attacking bear. Two studies of the effectiveness of bear spray that had capsaicin as its active ingredient demonstrated its effectiveness but noted possible interference with wind (Herrero and Higgins 1998, Smith et al. 2008).

Fifth, in 38% of fatal black bear attacks, people’s food or garbage was present and the bear either fed on it or oriented toward it, suggesting that it may have attracted the bear and contributed to the attack. Our experience with bear behavior and attacks leads us to speculate that black bears that become increasingly aggressive in going after peoples’ food or garbage have an increased chance of initiating a serious or fatal attack. People’s unsecured food or garbage is recognized as being a root cause of human–bear conflict (Herrero 1985, 2002; Beckmann et al. 2004). We are not suggesting that poorly secured food or garbage usually contributes to fatal attacks, however, on some occasions it has, which is another reason for highly bear-resistant management of people’s food and garbage. Fatal and other serious black bear attacks that might have been predicted and avoided by management actions have resulted in lawsuits that awarded large settlements in compensation to the injured person. It is therefore important to recognize circumstances and black bear behavior that might increase chances of serious or fatal attack.

Sixth, most fatal black bear attacks were predatory and all fatal attacks were carried out by 1 bear. With training, people can learn to recognize the behavior of a bear that is considering them as prey. Potentially predatory approaches are typically silent, and may include stalking or other following, followed by a fast rush leading to contact. We know of

incidents where a black bear behaved as if it were considering or carrying out a predatory attack and was deterred by people’s aggressive actions such as shouting, or hitting with rocks, fists, or sticks. Once predatory behavior is initiated it may persist for hours unless it is deterred. After 1 person has been killed by a black bear, the bear may attempt or succeed in killing other nearby people, as demonstrated by the 3 incidents in which 2 or 3 people were killed. Such bears appear to be strongly motivated, as if a switch had been thrown. Once a black bear has killed a person there is an increased chance that it will try to kill other people. Such bears should be removed from the wild. Some of the attacks that we did not classify as predatory may have in fact been predatory, as our criteria for classifying incidents as predatory were strict.

Seventh, male bears were responsible for most predatory attacks, likely reflecting biological and behavioral differences between male and female bears. Females select habitat and behave to support security (Garneau et al. 2008). On the other hand, male black bears typically have larger home ranges, exposing these bears to more risks because of more potential interactions with people, especially if the bear population is hunted (Pelton 2003). Males represented 60% of the hunting harvest in the United States and 74% in Canada from 1999 to 2001 (Hristienko and McDonald 2007). In Canada there was a similar total black bear harvest (20,184 bears) as in the lower 48 states (21,080 bears), but there was substantially less hunting pressure in Canada than in the United States (i.e., 59,387 hunters vs. 313,727 hunters, respectively) on a larger black bear population during 1999–2001. With far less hunting pressure more bold males survive. Males take more risks to feed and fatten to be able to compete with other males to breed (Noyce et al. 2001, Garneau et al. 2008). We see predation on a person as being a rare, high risk activity with a potentially high food reward, in which a bear might ingest much quality food by feeding on a person, but also will probably be killed by other humans.

Eighth, given the strength and opportunistic predation by black bears one can ask why bears do not prey on people more often. Part of the answer may be that bears that try to or do prey on people are usually killed and removed from a population’s gene pool, decreasing the frequency of any genes the individual might have had that could contribute to predatory attacks on people. It is well known among dog breeders that it is possible to selectively breed for or against aggression. It is highly likely that this selection would also be possible for bears. It may also be true that individual bears

Table 1. Activity of victim prior to American black bear fatal attack, Canada and United States, 1900–2009.

Occupational	Camping	Homesite	Hiking	Other	Unknown	Total
8 ^a	10 ^b	8 ^c	8 ^d	20 ^e	9	63

^a Geological exploration = 3; Forestry = 2; Working on a drill rig = 2; Trapping = 1.

^b Back-country camping = 6; Front-country camping = 4.

^c Back-country homesites = 5; Front-country homesites = 3.

^d Hike quietly = 3; Hike, unknown noise level = 2; Walk = 3.

^e Playing = 4; Fishing = 5; Sitting = 3; Hunting = 1; Filming = 1; Jogging = 1; Horse riding = 1; Berry picking = 1; Biking = 1; Picking wild plums = 1; Feeding bear = 1.

that try to prey on people are normal bears responding to opportunity or circumstance and that their genetic makeup is typical of the population they are part of.

Ninth, in about 30% of fatal attacks bear health problems were identified that may have contributed to predatory behavior. A food-stressed bear may be more willing to take risks such as those that occur during attempted predation. Most bears involved in fatal attacks were thought to be healthy.

Finally, we found no instances of a black bear attacking and killing a person near an animal carcass. In this regard, black bear behavior around ungulate carcasses was different than that of brown bear (*U. arctos*). Brown bears occasionally attack or even kill people in defence of an ungulate carcass or to claim a carcass (Herrero and Higgins 1999, 2003), thus supporting the view that black bears are generally less aggressive than brown bears (Herrero 1985).

Reducing Risks From Black Bears

Coupled with human dimensions insight about perceptions of risk associated with human–black bear interactions, our results can contribute to reducing risks from black bear, including fatal black bear attacks and circumstances associated with fatal and potentially fatal attacks. Knowledge of fatal attacks may be used to manage assessed and perceived risk (Knuth et al. 1992; Gore et al. 2005, 2007). Both assessed and perceived risks from black bear are important given the large black bear populations in Canada and the United States. As conflicts between humans and black bear continue to increase (Beckmann et al. 2004, Gore 2004, Beckmann 2009) accurate information becomes fundamental to informed human–bear conflict management. Communicating about black bear–inflicted human fatalities in a statistical manner can contribute to better understanding about black bear attacks, further reduce chances of serious injury or death, and promote public appreciation about black bear. However, we note that an analysis of fatal attacks that occurred over a long time period (110 years) may make black bear seem more dangerous than they are, because some people may focus on the total number and ignore the long time period during which the fatal attacks occurred.

Approaches such as intensive hunting (McDonald 2003, Ternent 2008) or supplemental feeding (Ziegeltrum 2004) have been suggested to reduce depredations and serious black bear attacks. Although these approaches may be effective this has not been scientifically demonstrated and they are controversial (The Wildlife Society 2007).

MANAGEMENT IMPLICATIONS

An important management strategy to reduce potentially fatal and other black bear attacks is to inform people how to avoid and manage aggressive encounters with black and other bear species. Strategies such as carrying deterrents like bear spray, traveling in groups >2 people and being alert for bears and bear sign are well known and are supported by our results. It is also important to be able to recognize bear behaviors preceding serious attacks, as we described,

and to know how to deter aggressive bears (Herrero, 1985, Herrero, 2002, Safety in Bear Country Society 2009). A person should try to aggressively deter or fight off a potentially predatory bear using all possible deterrents such as bear spray, loud noises, fists, firearms, rocks, knives, or clubs. If a bear acts stressed and is showing defensive threat behaviors, then a predatory attack is unlikely, which is counterintuitive to many people because the bear is acting aggressively. However, this aggression is defensive, and if the bear is given space it will likely leave. Also, if an aggressive female with young is encountered, a predatory attack is extremely unlikely since most predatory attacks by black bear were by single male bear. While female black bear, even with cubs, seldom attack people they can be provoked into attacking if harassed by people or dogs (Herrero 1985, Herrero 2002; Herrero and Higgins 1999, 2003). The nature of fatal attacks by black bear is somewhat different than fatal attacks by brown bear. For brown bear a substantial proportion of serious and fatal attacks are defensive and are carried out by a female with young (Herrero 1970; Herrero and Higgins 1999, 2003).

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LITERATURE CITED

- Beckmann, J. P., 2009. Bears will be bears. *The Wildlife Professional* 3:50–52.
- Beckmann, J. P., C. W. Lackey, and J. Berger. 2004. Evaluation of deterrent techniques and dogs to alter behavior of nuisance black bears. *Wildlife Society Bulletin* 32:1141–1146.
- Demographia and the Public Purpose, Wendell Cox Consultancy. 2001. US population from 1900. <<http://www.demographia.com/db-uspop1900.htm>>. Accessed 3 Mar 2010.
- Eager, J. T., and M. R. Pelton. 1979. Panhandler black bears in the Great Smoky Mountains National Park. Report submitted to: United States National Park Service, Southeast Region, Atlanta, Georgia, USA.
- Garneau, D. E., T. Boudreau, M. Keech, and E. Post. 2008. Habitat use by black bears in relationship to conspecifics and competitors. *Mammalian Biology* 73:48–57.
- Garshelis, D. L., and H. Hristienko. 2006. State and provincial estimates of American black bear numbers versus assessments of population trend. *Ursus* 17:1–7.
- Gniadek, S. J., and K. C. Kendall. 1998. A summary of bear management in Glacier National Park, 1960–1994. *Ursus* 10:155–159.
- Gore, M. L. 2004. Comparison of intervention programs designed to reduce human–bear conflict: a literature review. Human Dimensions Research Unit. Cornell University, Ithaca, New York, USA.
- Gore, M. L., W. F. Siemer, J. E. Shanahan, D. Schuefele, and D. J. Decker. 2005. Effects on risk perception of media coverage of a black bear-related human fatality. *Wildlife Society Bulletin* 33:507–516.
- Gore, M. L., B. A. Knuth, P. D. Curtis, and J. E. Shanahan. 2007. Factors influencing risk perception associated with human–black bear conflict. *Human Dimensions of Wildlife* 12:133–136.

- Gunther, K. A. 1994. Bear management in Yellowstone National Park, 1960–93. *International Conference on Bear Research and Management* 9:549–560.
- Herrero, S. 1970. Human injury inflicted by grizzly bears. *Science* 170:593–598.
- Herrero, S. 1983. Social behaviour of black bears at a garbage dump in Jasper National Park, Alberta. *International Conference on Bear Research and Management* 5:54–70.
- Herrero, S. 1985. Bear attacks: their causes and avoidance. Lyons & Burford, New York, New York, USA.
- Herrero, S. 2002. Bear attacks: their causes and avoidance. Revised edition. Lyons & Burford, New York, New York, USA.
- Herrero, S., and A. Higgins. 1995. Fatal injuries inflicted to people by black bears. Pages 75–81 in J. Auger, and H. Black, editors. *Proceedings of the 5th Western Black Bear Workshop*, Brigham Young University Press, Provo, Utah, USA.
- Herrero, S., and A. Higgins. 1998. Field use of capsicum spray as a bear deterrent. *Ursus* 10:533–537.
- Herrero, S., and A. Higgins. 1999. Human injuries inflicted by bears in British Columbia: 1960–97. *Ursus* 11:209–218.
- Herrero, S., and A. Higgins. 2003. Human injuries inflicted by bears in Alberta: 1960–98. *Ursus* 14:44–54.
- Herrero, S., T. Smith, T. D. DeBruyn, K. Gunther, and C. A. Matt. 2005. From the field: bear habituation to people—safety, risks, and benefits. *Wildlife Society Bulletin* 3:362–373.
- Hristienko, H., and J. E. McDonald. Jr. 2007. Going into the 21st century: a perspective on trends and controversies in the management of the American black bear. *Ursus* 18:72–88.
- Information Please, Pearson Education. 2010 Infoplease. <<http://www.infoplease.com>>. Accessed 3 Mar 2010.
- Jordan, R. 1976. Threat behavior of the black bear (*Ursus americanus*). Page 61 in M. R. Pelton, J. W. Lentfer, and G. E. Folk, editors. *Third International Conference on Bear Research and Management*. International Union for the Conservation of Nature, New Series No. 40, Morges, Switzerland.
- Knuth, B. A., R. J. Stout, D. J. Decker, and R. C. Stedman. 1992. Management concepts for improving wildlife population decisions and public communication strategies. Pages 63–74 in *Transactions of the 57th North American Wildlife and Natural Resources Conference*, 27 March–1 April 1992. Wildlife Management Institute, Washington, D.C., USA.
- McDonald, J. E. Jr. 2003. Bears and moose in Massachusetts: the past, the present and the future possibilities. *Transactions of the North American Wildlife and Natural Resources Conference* 68:225–234.
- Middaugh, J. P. 1987. Human injury from bear attacks in Alaska, 1900–1985. *Alaska Medicine* 29:121–126.
- Miller, S., and V. L. Tutterow. 1998. Characteristics of nonsport mortalities to brown and black bears and human injuries from bears in Alaska. *Ursus* 11:239–252.
- Noyce, K. V., D. L. Garshelis, and P. L. Coy. 2001. Differential vulnerability of black bears to trap and camera sampling resulting in biases in mark-recapture estimates. *Ursus* 12:211–226.
- Pelton, M. R. 2003. Black bear. Pages 547–555 in G. A. Feldhamer, B. C. Thompson, and J. A. Chapman, editors. *Wild mammals of North America. Biology, management and conservation*. Second edition. Johns Hopkins University Press, Baltimore, Maryland, USA.
- Safety in Bear Country Society. 2009. Staying safe in bear country [video]. Distribution Access, Toronto, Ontario, Canada.
- Smith, T. S., S. Herrero, T. D. DeBruyn, and J. M. Wilder. 2008. Efficacy of Bear deterrent Spray in Alaska. *Journal of Wildlife Management* 72:640–645.
- Ternent, M. A. 2008. Effect of lengthening black bear hunting seasons in northeast Pennsylvania on harvest rates of nuisance bears and population size. *Proceedings of the Eastern Black Bear Workshop* 19:90–97.
- The Wildlife Society. 2007. Final TWS position statement: baiting and supplemental feeding of game wildlife species. The Wildlife Society, Bethesda, Maryland, USA.
- Whitlock, S. C. 1950. The black bear as a predator of man. *Journal of Mammalogy* 31:135–138.
- Wikimedia Foundation Inc. 2010. Population of Canada by year. <http://www.wikipedia.org/wiki/List_of_population_of_Canada_by_years>. Accessed 3 Mar 2010.
- Williamson, D. F. 2002. In the Black: Status, Management, and Trade of the American Black Bear (*Ursus americanus*) in North America. TRAFFIC North America. World Wildlife Fund, Washington, D.C., USA.
- Ziegeltrum, G. J. 2004. Efficacy of black bear supplemental feeding to reduce conifer damage in western Washington. *Journal of Wildlife Management* 68:470–474.

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