Human–Wildlife Interactions 5(2):177–191, Fall 2011

Aggressive body language of bears and wildlife viewing: a response to Geist (2011)

STEPHEN F. STRINGHAM, WildWatch LLC, 39200 Alma Avenue, Soldotna, AK 99669, USA
gobearviewing@hotmail.com

Key words: attack, bear, behavior, broadside display, communication, curiosity, frontal display, human–wildlife conflicts, threat, *Ursus*, viewing

GEIST'S (2011) COMMENTARY has 3 main points: (1) habituation increases risk that large-bodied wildlife will injure people; (2) an animal's body language often provides reliable clues of impending assault; and (3) although some of those clues are obvious, others are easily overlooked by untrained people. Whereas Geist's emphasis is on ungulates, he also suggests that similar behaviors by bears have the same significance; this is an issue that requires clarification.

The importance of recognizing signals that sometimes preface attack is beyond questioning for those of us who frequently encounter potentially dangerous wildlife, whether as professional or recreational observers. However, as Geist agrees (personal communication), that information is most valuable if one also knows of any benign contexts in which the same or similar signals appear and their relative frequency in each context. Otherwise, a person is not only at risk from overlooking or misinterpreting threats, but also from mistaking benign behaviors for preludes to attack. This can cause people to overreact in ways that actually increase their likelihood of being assaulted, albeit defensively.

Craighead (1972) describes a classic example. Even a grizzly bear (*Ursus arctos*) that would normally flee from a human will sometimes approach. A person who does not realize that the bear is approaching out of curiosity may make the mistake of not alerting the bear (e.g., by snapping branches or thrashing brush) while it is still far away, and instead try to hide. This reaction increases the risk that the bear would not recognize the situation until it is within its attack distance. In such a case, the bear's approach, especially at a run, often is misinterpreted as aggressive and may lead someone to run from the bear or to shoot it.

Shooting risks retaliation by the bear, a risk that is especially high for emergency shooting (Stringham 2008, Smith et al., in press). Defensiveness is the major cause of serious or fatal injuries inflicted by brown bears (*Ursus arctos*) and a cause of lesser injury by black bears (*Ursus americanus*) Herrero 1985, Herrero and Higgins 1995, 2003).

Geist (1978) and Walther (1984) provide much of the information on contexts for agonistic signals by ungulates; but little of it has been published for bears, and that little is widely scattered through the literature. In this paper, I summarize that literature plus my own findings. These are based on 22 field seasons observing bears and bear viewers—15 seasons with brown bears in Alaska and 7 with black bears in Alaska, New York, Vermont and California. During 13 of these field seasons, I worked part-time guiding bear viewers and observing the bears. As director of the Bear Viewing Association, I track and analyze broad-scale patterns in viewing. Analysis of my data has proceeded far enough to permit qualitative descriptions, ordinal comparisons, and order of magnitude numerics. More precise quantitative results and methodological details will be published later. Unless otherwise stated, all references to "bears" herein refer just to Alaskan brown bears and black bears. How well these findings apply to other ursidae remains to be determined.

Viewing bears and other wildlife

Over recent decades, viewing of wild ungulates, especially large carnivores, has grown from the pastime of an eccentric minority of North Americans to a major form of eco-tourism that attracts visitors from around the globe. No large carnivores are more accessible or more charismatic than bears. The continent's 4 most popular bear-viewing sites—Wolverine Creek and Brooks River in Alaska, the North American Bear Center, and Vince Shute wildlife sanctuary in Minnesota—together amount to

Figure 1. At some popular viewing areas on the Alaska seacoast, viewers can legally approach brown and black bears to within 50 to 100 m. Viewers can also legally allow bears to approach as close as they want. The decision of "how close is too close?" is left to the guide. So long as viewers remain seated, bears learn to feel confident in approaching closely; and a guide standing up is often sufficient to deter the bear from coming closer.

roughly 70,000 viewer-days per year. Continent wide, the total is estimated at >100,000 viewer-days at sites where bears are reliably seen, in addition to Yellowstone and some other national parks where bear sightings are much more chancy (Stringham, unpublished report). Whereas visitors can enjoy the Minnesota and Yellowstone sites for little more than the cost of driving, visits to roadless Alaskan sites can cost >$200/hour for viewing.

Alaska has all 3 species of North American bears. These are most reliably viewed at concentrations of high-energy foods, such as a beached whale carcasses or salmon streams. These features, plus spectacular scenery, provide some of the most varied, abundant, and high-quality bear-viewing sites on our planet (Stringham 2007). Viewing has, thus, become a substantial source of income for Alaska and an economic cornerstone of some communities, such as Kaktovik on the Beaufort Sea, Kodiak on the Gulf of Alaska, and Homer, the so-called bear-viewing capital of the world, on Cook Inlet. When all wildlife species are considered, viewing in Alaska generates around $700 million per year (DeBruyn and Smith 2009).

At only a handful of sites is bear viewing done from vehicles or platforms that minimize exposure of humans to bears. At the >100 other North American sites, viewing is done on the ground, often at distances of 5 to 100 m from the bears, which is close enough for bears to reach the people at will (Figure 1; Stringham 2007, 2008, 2009; <www.bear-viewing-in-alaska.info>).

Safety for people at exposed sites depends primarily on the bears' tolerance and self restraint. In the event that a bear does become aggressive, viewers commonly expect deterrents, such as pepper spray or flares, to keep them safe. But these chemical and mechanical deterrents are merely handy backups, of limited effectiveness. They should not be relied on as a substitute for being able to avoid or quell aggression by assessing a bear's mood and intentions from its body language, then responding appropriately (Stringham 2002, 2008, 2009) Failure to do so can have tragic consequences, as exemplified by the fatalities of bear naturalist Vitaly Nikolayenko (Mosolov and Gordienko 2004) and of various photographers, such as Michio Hoshino, Timothy Treadwell, and Amy Huguenard (Jans 2005).

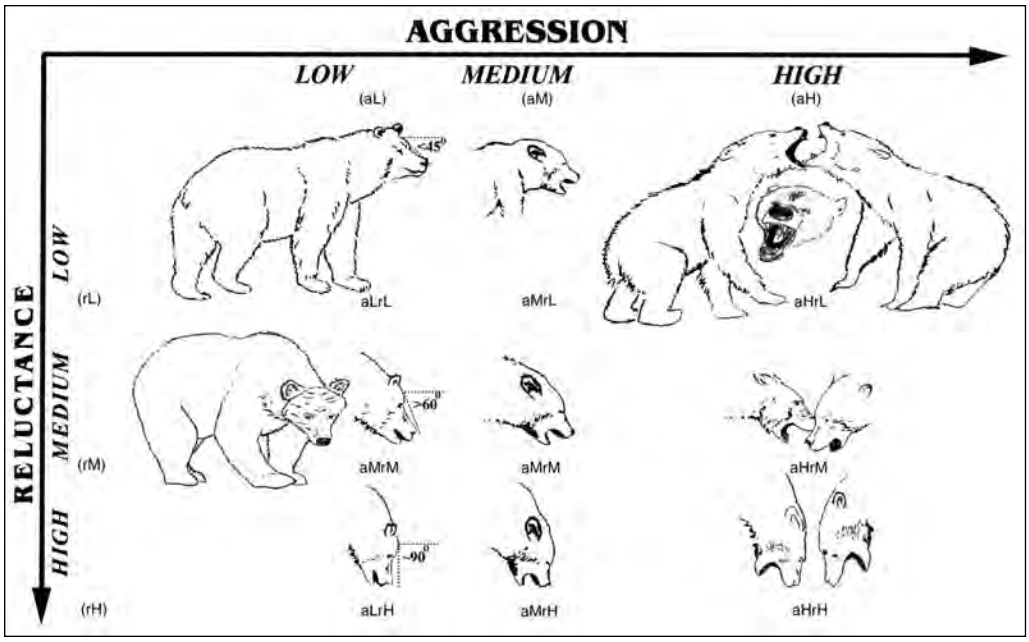

Figure 2. Body language associated with various combinations of competing motivations—aggression versus reluctance for combat. Levels of aggression: Low (aL), Medium (aM), High (aH). Levels of reluctance: Low (rL), Medium (rM), High (rH). Top, left to right, from the upper left corner: in a confident, assertive, slightly aggressive mood, a bear commonly walks or stands with its face 30 to 45º below horizontal and its neck at an angle between 30 and 45º degrees above or below horizontal. As aggression increases, the mouth gapes more widely, the upper lip extends farther, and the upper canines are exposed to the opponent's view. Simultaneously, vocalizations become harsher and more prolonged until the bear is roaring. Bottom left: assuming that the function of threats is to win without chancing injury through fighting, a bear reduces risk that its escalating aggression will provoke attack by the opponent by aiming its jaws away from the opponent. I refer to this counter-signaling as reluctance. Bottom center: as reluctance increases, neck angle tends to drop farther below horizontal, and face angle drops towards vertical. Bottom right: aggression and reluctance are both intense, signaling a highly unstable balance of motivations that can suddenly tip into either attack or submission. A bear eventually tries to de-escalate a confrontation by turning its head and jaws to the right or left, away from the opponent, watching the latter with peripheral vision only. Another form of reluctance is seen when mothers threaten cubs with lowered head to prevent them from nursing or stealing pieces of salmon. Assertive cubs respond with head-low threats.

Bear threats that even novices can recognize

Postures and gestures

Elements of body language commonly used by brown and black bears during agonistic encounters with conspecifics have been described by Herrero (1970, 1983), Burghardt and Burghardt (1972), Stonorov and Stokes (1972), Craighead (1972), Henry and Herrero (1974), Egbert and Stokes (1976), Pruitt (1976), Pruitt and Burghardt (1977), Jordan (1974), Jordan and Burghardt (1986), Ludlow (1976), Bledsoe (1987), and Stringham (2002, 2008, 2009). Elements used toward fellow bears appear to be identical to those used towards humans.

Figure 2 shows a matrix of postures manifesting low, medium and high levels of aggression and comparable levels of reluctance to fight, resulting in 9 combinations of the 2 motivations (Stringham 2008, 2009). Aggression and likelihood of combat peak at cell aHrL (= aggression High, reluctance Low), where 2 bears face off with their nostrils <1 m apart, each bruin's head high above its shoulders, and body weight centered on its legs to free its arms for grappling, swatting, clawing and fending off attacks. The upper lip puckers forward as the mouth gapes widely and is tilted upwards far enough that the upper canines are exposed to the opponent's view. Each bear tilts its head to the right or left so as to better grasp and neutralize or damage the opponent's jaws (Geist 1972). Each bear may alternately raise and lower its head momentarily as though seeking an opening to bite the opponent's neck or cheek. Alternately, changes in relative head height may reflect momentary changes in self-

confidence, with the currently more confident bear holding its head highest. Both bears typically roar loudly and continuously.

As Jordan (1976), Egbert and Stokes (1976), and Bledsoe (1987) emphasize, the elements of threat behavior may be stereotyped, but the sequences, durations, and combinations of elements vary from instance to instance due in part to constant adjustment by each bear to its opponent. Only suites of actions can be grouped into relatively predictable stages (Pruitt 1976). Combat is usually preceded by head-high threats, which are usually preceded by head-low threats, which are very occasionally preceded by broadside displays. Likelihood of immediate combat is higher when bears face off with heads high and jaws—their primary weapon—aimed at the opponent, than when their heads are low, aiming jaws away from the opponent, usually at the ground (Egbert and Stokes 1976, Jordan 1976).

Lowering the jaws to ground level (Figure 2, aHrH) while roaring continuously or bellowing in rapid pulses can be thought of as extreme ursine saber rattling. Aiming one's weapons away from an opponent allows one to express intense aggression with less risk of triggering attack by the opponent.

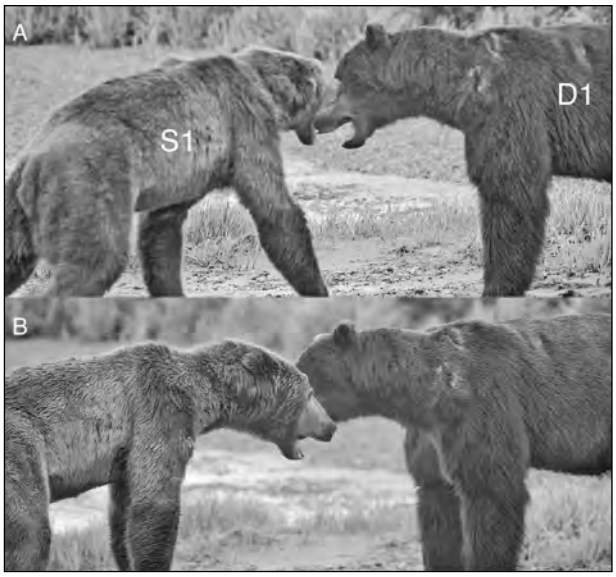

Figure 3. Appeasement of a subordinate by a dominant bear. (**A**) A subordinate brown bear, S1 (upper left in photo) threatened a higher-ranking adult male, D1, when D1 ventured too close, even though D1 did not overtly threaten S1. S1's fearful assertiveness is indicated by its moderate-aggression, low reluctance threat with head high, ears back tightly against its skull, and fully gaping jaws aimed at D1. S1's upper canines were not exposed, and much of its weight was on its arms, rather than shifted to its legs, suggesting that it was defensive and not ready to fight. D1 responded with combined displays of dominance and reluctance to fight. D1's dominance was indicated by its ears forward and head high, while it appeased S1 by holding his jaws at only half-gape and turned away from S1. D1's head-high posture also kept its jaws in position to counterattack if S1 tried to bite.
(**B**) S1 was calming down, with its mouth now at only half-gape and its jaws lowered and turned aside, even though its body was still aimed at D1. (*Photos courtesy T. Guzzi*)

Whereas head-high weapon threats normally begin when the nostrils of the 2 bears are <1 m apart, head-low threats may begin while the 2 bears are several meters away. Further, whereas head-high threats are virtually always made face to face, a head-low threat may be made from any angle from which the aggressor happens to approach its opponent.

Offensive challenges

When a brown bear walks deliberately towards an opponent, escalation of aggression is unlikely if the opponent acknowledges subordinance by backing up a few paces and turning its neck and head to the side. If the approaching bear has made no overt threat display (Figure 2, cells aLrL–aMrL), the opponent may even sit down, likely facing away from the challenger. However, if the opponent does not acknowledge subordinance, the challenger may stiffen its gait, thereby escalating its threat. If the opponent still fails to submit or counter threatens, then aggression is much more likely to escalate into more intense visible and audible threats, and, perhaps, into combat (Craighead 1972, Stonorov and Stokes 1972).

Whether or not combat occurs, confrontations typically end with gradual de-escalation of tensions. This culminates in each bear pointing its jaws toward the ground and lowering its head, with the loser's head lowest. Then one or both bears turn their head aside. If the rank difference is small, the loser usually turns its head aside first, perhaps after having backed

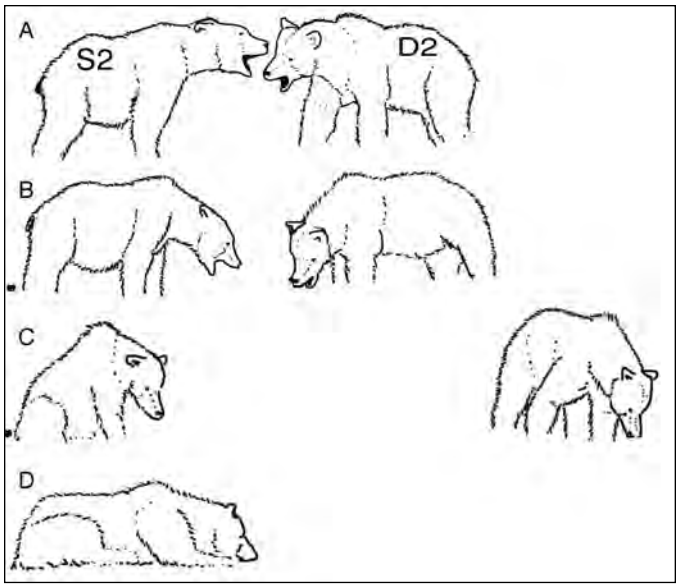

Figure 4. Subordinate appeasing a dominant. (**A**) Defensive aggression where an adolescent male S2 threatened adult male D2. Although much of the body language in this case is like that in Figure 3, there are important differences. First, S2's head was initially higher than D2's, indicating a brief period of high self-confidence before D2's imperturbability unnerved S1. S1's failing confidence is manifest in the flattening of his ears and the lifting of his tail and then defecation. Even though D2 held his head lower than S2, he clearly dominated the encounter, never becoming excited. (**B**) When these bears began to de-escalate, they did so by both lowering their heads, before either bear turned away. (**C**) S2's subordinate status was confirmed as he sat down with his head lowered and turned partly aside as he closely watched D2 who resumed grazing and turned away from S2, as though unconcerned with S2 as a potential threat. (**D**) Finally, S2 lay down, still facing D2. Although lying down can be an extreme form of submission, it is far less common in bears than in dogs or wolves, and occurs only when attack risk is low, not during a tense, close encounter.

up ≥1 steps. However, if the rank difference is large, the loser may not dare turn aside and increase its vulnerability; so, the dominant is left to do so first. Losers almost never challenge a winner even during these moments of vulnerability (Craighead 1972). At this stage of a conflict, the movements of a subordinate bear often seem stiffer than those of a dominant, the ultimate expression of stiffness being immobility. Perhaps a subordinate bear, like a human, can be too afraid to move lest it trigger attack. In any event, Stonorov and Stokes (1972) found that subordinates are 4-fold (n = 12 versus 3) more likely than dominants to turn their head and neck broadside to an opponent. In the uncommon event that an infant or yearling challenges an adult, it is likely to be ignored, even as the adult watches lest the cub's mother appear to back up its threats.

Defensive challenges

When a bear with its neck roughly level (Figure 2, aMrL) defensively threatens a much higher-ranking opponent, the dominant individual may refrain from chastising its challenger and instead try to appease it by facing away from the subordinate, while holding its head at a similar height (Figures 3a and 4a). Facing away simultaneous-ly signals the dominant's imperturbability and its benign intent. Typically, neither bear has its head high enough to reveal its upper canines. As the aggressive subordinate calms down (Figures 3b and 4b), it will eventually back up and turn away from the dominant, perhaps lowering its head even if the dominant does not.

This scenario is common when a mother deters an adult male from approaching her cubs, even though the male is just passing by, not hunting her cubs. Furthermore, even during the most intense phase of roaring match with an adult male, a mother may momentarily turn her head aside to check on her cubs without this acknowledging subordinance.

A bear, especially the loser, can be so physically and emotionally exhausted by a confrontation that it soon sits down and may even lie down, while remaining wary of the winner (Figures 4c and 4d). Although depression is more typical of losers than of winners, I have seen a mother who saved her cub from a predatory male soon lie down and hardly move for >6 hours, providing no care to the injured cub and ignoring pleas by both her cubs to nurse.

Audible signals

Ursid postures indicating low to medium aggression (aL to aM), combined with medium to high reluctance (rM–rH), are often accompanied by distinctive sounds. These include 1 or 2 explosive woofs, followed by a series of pant huffs and by jaw popping (i.e., a combination of

snapping the jaws together and popping the lips as the mouth opens). These signals may precede or accompany the bear hopping or running forward a few steps towards the opponent, terminating with a single explosive woof as the bear slams one or both hands against a tree or the ground, much as some ungulates do with their hooves. This is commonly followed by further pant-huffing and jaw-popping.

Threats versus attacks

Those signals can all be highly intimidating to opponents, including humans. However, only a minority of such displays leads to attack, especially if the displaying bear is appeased by its opponent, that is, by a human giving it more space or ceasing to threaten it (Leslie 1968, Stringham 2009; Herrero 1972 *a*, *b*; Herrero et al. 2011). Each summer for the past few years, Ann Bryant (director, BEAR League, Lake Tahoe, California, personal communication) and her assistants have chased black bears out of yards and homes at Lake Tahoe on the California-Nevada border, without suffering even slight injury, despite being threatened in the above ways on hundreds of occasions. Rogers, Mansfield, and their colleagues have faced these displays by black bears many times, none of which has ever caused them even moderate injury, although they have rarely suffered scratches and bruises. Other biologists (e.g., Faro, personal communication) and guides (e.g., B. Josephs, B. Wilde and K. Fredriksson, guides, Katmai Coastal Bear Tours, personal communication), myself included, have escaped being attacked, despite having faced hundreds of threats, sometimes including short rushes or hop-slams, by brown bears on the seacoasts of Alaska and British Columbia.

One reason that attacks so rarely follow threat displays is that threats are not announcements that an animal plans to attack, but attempts by the animal to achieve its goals by manipulating its opponent, without risking a fight (Geist 1978). Although an offensive threat does warn that attack is imminent if its goals are not met (e.g., unless a competitor retreats or surrenders food), the aggressor seldom follows through, perhaps out of fear. Attack is even less likely following a defensive threat, which warns that the individual will, in theory, retaliate only if attacked, threatened, or otherwise provoked (Ewer 1968). Threats can also be used to manipulate a social partner (e.g., an infant that insists on nursing or that keeps biting in play) without risk of injuring the partner.

In the uncommon event that a bear is motivated to attack a person, the attack is more likely to be inhibited by fear of retaliation than by concern for the human. Nevertheless, when a bear is in a benign mood, it may go to considerable trouble to deter a person without doing harm. On several occasions, I have had a captive bear stop me from touching it by catching the skin of my hand in its incisors, then letting go, without breaking or bruising the skin. Kilham (2002) refers to restrained bites to a human or fellow bear as message bites. Restrained swats, with claws lifted so they do not make contact, are also used to deliver messages. On occasion, a wild black bear has deterred contact by my hand by directing its gaping mouth at me, even though the bear was otherwise content have its body within inches of me or sometimes pressed against me.

In lieu of inhibition, an angry animal would theoretically just attack without preamble (Lorenz 1966). I have seen numerous instances of a black or brown bear suddenly lash out at a conspecific standing beside it feeding on an animal carcass or an insect laden log. If any warning was given, it was not apparent to human eyes or ears. In each case, the bears were siblings or constant companions. Where the 2 bears differed appreciably in size, it was usually the larger that attacked the smaller.

According to the same theory, a fearful animal that is not inhibited from withdrawing (e.g., by its own aggression or by expectation of attack from the rear) would just flee. Some bears run as soon as they detect a person nearby; others approach and threaten a person, then stalk off stiffly, occasionally spinning back to face the person, threaten, and continue to move away for a few hundred meters away before suddenly accelerating into a run, sometimes continuing for miles and disappearing from sight (Russell 1972).

There is no indication that bears so clearly reveal fear, anger or frustration during predatory attempts (Herrero 1985), despite the likelihood that each of these emotions sometimes occurs while trying to kill powerful prey, such as moose (*Alces americanus*), caribou (*Rangifer*

tarandus) or a fellow bear. I have seen video footage and photos of an adult male walking up to a distracted subordinate and attacking without preamble. In a 1997 incident at Brooks Falls, in Katmai National Park, the aggressor quickly began eating the subordinate, ripping flesh from its back; the adolescent hardly resisted as though immobilized by terror and shock. In a 2010 incident at the Russian River Falls, on the Kenai Peninsula, the adult male tore off a patch of skin from the victim's rump roughly 0.3 m in diameter, then held on, as though trying to force the adolescent underwater. Again, the victim did not fight back. This continued several minutes before the adult male desisted and shifted to fishing on salmon. At no time did the attacker make a detectable visible or audible threat.

In any attempt to assess attack risk, it is critical to keep in mind that probability that a threat display will be followed by attack is NOT directly related to intensity of the display; sometimes just the opposite. This is akin to the situation between 2 men or boys insulting one another, where the louder and longer the harangue continues, the less likely it is to end with fighting. In fact, it can serve as an alternative way of letting off steam. At least, that was my own experience as a youth, when fistfights occurred several times a day. Rogers and Mansfield, thus, refer to intense pant-huffing, jaw-popping and hop-charging as blustering. One hypothesis is that these signals have become so ritualized that they, like human cussing or dog barking, reveal less about intentions than about emotions.

Any attempt to determine how well a given display predicts assault should distinguish how often assault is prefaced by the display versus how often the signal prefaces aggression versus other behavior. Even if all assaults were preceded by a certain gesture, this would not preclude that same gesture from preceding or accompanying other actions. Indeed, elements of aggressive body language are common during play (e.g., puckered upper lip, ears back against the skull, head tossing, biting, and wrestling). The fact that a display is typical of aggression does not mean it is diagnostic thereof. Diagnosis requires recognition of entire gestalts of signals and of their contexts.

Ungulates versus bears

Cryptic displays

Recall that the focus of Geist's (2011) paper was not such obvious threats, but what he called "silent signals" that only trained observers are likely to recognize as such. Three of the most common of these are broadside displays, averted gaze, and deceptive grazing.

Even novices are likely to recognize the threat implied when a cervid or bovid faces them and directs its antlers or horns at them. However, according to Geist (1978, 2011) and Walther (1984), novices are less likely to recognize the significance of a broadside display. When such a display is performed by 2 ungulates, they walk parallel to one another or circle in reverse parallel positions, with each animal's head toward the opponent's tail.

Even when a broadside display is directed toward people, "the displayer does not approach directly, but at a tangent; that is, it circles onto the object of display" (Geist 2011). People could easily mistake this for the animal just walking past them—a misinterpreted impression augmented by the tendency of a displaying ungulate to direct its gaze or at least its muzzle away from the conspecific or human opponent, as though uninterested in the opponent. Threat is particularly hard to recognize when an ungulate grazes as it approaches an opponent.

The danger to someone who misinterprets a broadside display is greatest with species like mountain goats (*Oreamnos americanus)* that normally attack from a broadside position, rather than head to head, as with bighorn sheep (*Ovis canadensis;* Geist 1964). A mountain goat lowering its head and turning it away from an opponent might just be cocking its neck and shoulders in preparation for attack.

Geist suggests that broadside displays, averted gaze, and deceptive grazing have the same significance in bears as in ungulates. However, even if those behaviors do occasionally precede assaults—if only on a fellow bear—they are not diagnostic of pending assault. In situations where Rogers and Mansfield (personal communication), and I have observed black and brown bears, those behaviors are orders of magnitude more likely to accompany nonvio-

Figure 5. Old Snagletooth (right) and a second male (not visible in photo) were strutting in circles around one another, while an estrus female grazed nearby. Note how Snagletooth's arms and legs are spread much wider than those of the female, who is in a normal quadrupedal stance, with her right and left feet separated <0.5 m, whereas his extended 1.2 m. The male's body, especially his hindquarters, are covered with mud from wallowing where he had just urinated, such that he reeked of his own pheromones.

lent interactions with conspecifics or with people. When attacks do occur, they are typically prefaced by the overt displays described earlier; or the bear charges without warning, whether defensively or offensively. Sudden attacks seem more typical of brown bears than of black bears.

Broadside displays

Geist (2011) states: "In both ungulates and bears, the most important [cryptic] signal to watch for is the dominance display. … [T]he usual dominance display of large terrestrial mammals, primates excluded, is a broadside display….." Geist (1978) and Walther (1984) describe broadside displays by a spectrum of ungulate genera. Except in those species, such as mountain goats that fight standing side by side, a broadside display seldom leads directly to fighting. The uncertainty of whether it will do so adds to the display's capacity to intimidate rivals. However, in the normal course of events, if a dominance contest cannot be settled with broadside displays, the animals escalate to frontal weapon threats, and only if that fails to establish a winner do they resort to fighting.

One would likewise suspect that among carnivores, which normally fight head-to-head, combat is much more likely to follow head to head threats than broadside dominance displays. I have seen both dogs and wolves begin fighting while they stood head to head, but not while they were in full anti-parallel orientation, as each individual sniffed the anus of its opponent.

During thousands of bear encounters, I have experienced no more than 10 occasions when a black or brown bear has walked past me, gotten partly or fully behind me, then rushed toward me several paces before terminating the rush, sometimes by slamming its hands on the ground. There was no way to tell whether the bear would have made contact had I not turned to face it; but taking my eyes off the animal likely gave it confidence, much as resuming eye contact halted its approach. However, in none of these cases was the bear making a stereotyped broadside display. The only forewarning of the impending threat was that, in each case, the bear walked toward me much more directly and perhaps more stiffly than normal, and with its eyes locked on me. A few colleagues have told me of similar experiences, and Jordan (1976) reports one with a black bear. Seldom have I seen 1 bear attack another that way, and it was always with a single bite or swat that caused no visible injury.

Bears make at least 2 forms of stereotyped broadside displays, both of which are highly distinctive and not readily mistaken for simply strolling past a person.

Sumo strut

Judging from experiences with brown bears in coastal Alaska, the most common form of broadside display exhibited by this species is the sumo strut. The bear walks forward, urinating. Urine flows onto its legs and runs down the fur, presumably picking up its scent, which is then ground into the soil by a repeated twisting motion of the feet. Its arms and legs are widely spread and its knee and perhaps elbow joints stiffened (Figure 5), as in the ceremonial preface to human sumo wrestling. The jaws of a sumo-strutting bear are aimed at the ground, not toward the opponent.

Sumo strutting is almost always made by pairs of rival adult males during the breeding season. Unlike ungulates and canids that circle one another within striking distance, sumo-strutting bears are usually separated by 2 to 10

body lengths. In the >100 cases of strutting that I have observed, never has a bear attacked from a broadside position. Seldom has a bear gone from a broadside display into a head-high, frontal threat and then begun fighting.

All cases of sumo strutting that I observed have been performed by an adult male toward another adult male, never by or towards any other age-sex class, although an estrus female is often nearby, raising the question of whether sumo strutting can serve a courtship role. Only twice have I seen a female (in each case a juvenile) perform something that resembled a mild, truncated sumo strut, and then for just a few steps while retreating facing away from me. S. Bryant (director, Bear League, Lake Tahoe, California, personal communication) has twice seen 2 mother black bears sumo strutting at one another.

I know of only 3 cases of sumo strutting being aimed at a person. V. Geist (personal communication) twice observed this when he drove a large adult male black bear away from him. Neither of those broadside displays was followed by frontal threats, much less by attack. In the third case, an adult male brown bear, Old Snagletooth (Figure 5), strutted directly towards me just after losing a confrontation with a larger male over an estrus female. When I spoke, "Don't do that," he immediately swung sideways to me, continuing to strut only briefly before walking off in a normal gait. In some cases, strutting seems to be a way of enhancing a bear's self confidence, as do the associated behaviors of wallowing or tree marking.

Stomp walk

Black bears also exhibit a second form of broadside display, dubbed stomp walking by L. Rogers and S. Mansfield (personal communication). As a bear walks forward, with its head nearly level with its shoulders, each forearm is alternately lifted to near horizontal position; then that forepaw is slammed down against the ground, whereupon it may slide forward <1 m.

Goosestep slide

Jordan (1976) describes a related behavior by a female, except that her forearms were locked, and she moved forward in something like a goosestep, with her hands sliding forward with each step. Her legs were not locked. But otherwise, as in sumo strutting, urine ran down her legs, and her body shook with each step.

The goosestep and slide, which seems transitional between stomp walking and sumo strutting, was frequently triggered by a human, but was not obviously oriented at the human. According to Jordan (1976), each bear's orientation relative to a person seemed random. In some cases, the bear was in an enclosure and was not free to circle the person or to walk far in any direction; so, the appearance of random orientation may have been an artifact. Or it may simply be an advertisement of the bear's mood that is broadcast "to whom it may concern" rather than to a specific opponent. This display was made by both males and females. It might be the same display that I earlier likened to a truncated sumo strut when I saw it made on 2 occasions by a juvenile female brown bear.

When a brown bear sumo struts, it may occasionally produce slide tracks similar to those made by a stomp walking black bear, further suggesting that sumo strutting and stomp walking may be polar forms of a display with several intergradations.

Cowboy walk

Black bears and, possibly, brown bears also make a face-to-face display where the forearms are lifted only several centimeters before the hands are slammed against the ground, step after step, accompanied by pant-huffing. This display typically ends with a hop-slam, accompanied by an explosive woof. This third form of stiff-legged gait is called cowboy walk because the elbows are sometimes turned out so far that the arms resemble the legs of a bowlegged horseman. Each time I have seen this, it accompanied a head-low threat.

Direct and diagonal charges

When a bear makes a full-fledged charge, it typically runs with its neck and spine aimed at the opponent. During some charges, the spine remains fairly level. In other charges, the spine oscillates up and down in kind of a rockinghorse motion; indeed, the bear may seem to be bouncing as much as running forward. My impression is that the greater the degree of rocking, the less likely the bear is to make physical contact with its opponent. Indeed,

rocking may serve to increase its apparent size, making it more intimidating to its opponent. An even less assertive brown bear will sometimes advance several paces with a rocking hop, during which its spine and neck are diagonal to the opponent, sometimes at just a slight angle and at other times at >45º angle. Stonorov and Stokes (1972) interpret angling of the body as a sign of ambivalence. Perhaps the angle increases along with strength of the motivation to flee, or at least to display broadside. A frustrated bear will sometimes hop in place without approaching its opponent, perhaps while flinging its head back and forth and casting saliva far and wide.

Predatory body language

None of that body language is seen during predation except for running, with or without a rocking motion. Bears that run through a stream to capture salmon move with a little rocking motion through water that is less than belly deep. But as depth increases, so does the height with which a bear lifts its forequarters before landing on its forefeet. Elevation of the forequarters not only lessens the effort of plowing through the water, but it may provide better visibility without having to stop and stand bipedally. The higher the angle from which a bear or person looks into water, the less visibility is impaired by surface reflections.

When hunting elk or moose calves, a bear may search by standing upright to see farther and to catch airborne scent, or by walking quadrupedally while following scent in the air or on the ground. Once prey is located, it may be circled or stalked, as the bear hides behind available cover with its gaze locked on the prey until the bear is close enough to attack. In rare cases, a bear will stalk prey in a crouched posture reminiscent of an African lion (*Panthera leo*; Pezzenti 2001) or crawl forward on its forearms with its chest against the ground, as observed on Kodiak Island on 2 occasions by deer hunter B. Garett (personal communication). There have also been numerous reports of polar bears (*Ursus maritimus*) crawling or swimming toward seals; an example of this behavior can be seen in BBC footage on YouTube (<http://www.youtube.com/watch?v=B0DCOTaZgtA>. If prey is discovered at close range, a bear may skip any searching or stalking and immediately charge the prey, pinning it with paws and biting into it.

All of those behaviors, except perhaps the predatory crouch (Shelton 2001), are seen in other behavioral contexts. So distinguishing instances of attempted predation from other motivations relies on gestalts of actions plus contextual cues, which are beyond the scope of this paper.

Some forms of predatory approach by a carnivore might indeed be mistaken as benign searching or curiosity, exemplified by coyotes (*Canis latrans*; Baker and Timm 1998) and wolves (*Canis lupus*; Geist 2007, 2011). Geist notes that predatory curiosity is commonly manifest in "attention to and following" or approaching another animal or person. This may culminate in physical contact and perhaps licking or nipping potential prey, eventually followed by attack (Geist 2007). However, he provides no other clues for distinguishing predatory versus nonpredatory curiosity among wolves or any other large bodied carnivores, or how often each occurs.

In the thousands of times that I have observed people, including myself, being followed or approached and investigated by a brown or black bear, none of those bears has ever made a recognizable attempt to test the focal person as prey. The only bears that mouthed any person were playful cubs. So long as a person does not try to touch a bear, injuries have been rare and usually limited to scratches; touching sometimes triggers more intense bite or clawing, but seldom prolonged mauling (Herrero 1985).

People who want to avoid a potentially dangerous animal should indeed be especially wary if the animal stares at them >30 seconds without sign of being alarmed or if it approaches or follows them with its eyes locked on them. However, no one should overreact by jumping to the conclusion that this reveals either agonistic or predatory aggression. There are many reasons besides aggression for a bear walking or even running toward a person or following the person. For example, I have had bears run at me to initiate play or to take shelter behind me from other bears. So, too, bears of all ages sometimes walk up to within a few meters of viewers, lie down, and go to sleep, apparently counting on proximity to humans to shield them from other bears – a phenomenon sometimes called shielding (Stringham 2009).

Which displays signal threat or dominance?

I have interpreted virtually all behaviors described thus far as agonistic in the contexts considered. Jaw-popping seems to be an intention movement to bite, comparable to jaw snapping in some canids or perhaps to molar grinding in moose and some other ungulates, even though these ungulates no long use teeth as weapons (Stringham 1974, Geist 1978). Rushing toward an opponent is intimidating in a wide range of mammals because the aggressor is both coming closer and appears to suddenly increase in size (Geist 1978). When a rush terminates with swatting the ground or a tree, accompanied by an explosive woof, this not only provides a sudden increase in noise, another widespread means of intimidation (Geist 1978), but it demonstrates the animal's power. Also, substrate slamming may draw attention to the bear's hands and its claws, and it can be interpreted as an intention to swat the opponent. For the same reasons, stomp walking and cowboy walking appear to signal intention to slam an opponent. Furthermore, both sumo strutting and sometimes stomp walking display the bear in broadside, which maximizes its apparent size, similar to what one sees in the majority of mammals and some other vertebrates (Geist 1978, 2011). When a bear near me tensely claws the ground or chews on a log while it stares at me, I likewise interpret those as threats to claw and bite me, even if those same bears, when later frightened by the appearance of a larger bear, then move behind me for protection. This is perhaps reminiscent of human adolescents who are aggressive toward adults, until need for adult assistance shifts them into a more juvenile role.

Nevertheless, there is reason for caution in labeling any of these displays as threats. First, stomp walking and sumo strutting, along with wallowing and tree rubbing, are also forms of scent marking. Mammals commonly use distinctive postures or gestures for drawing visual attention to where and when they scent mark, for instance with urine or feces. L. Rogers and S. Mansfield (personal communication), thus, hypothesize that stomp walking and perhaps sumo strutting may have become so ritualized that they are no more threatening than the leg lifting of a male dog or wolf. Second, some of these displays (e.g., pant huffing, woofing, and jaw popping) are made by bears of all ages and social ranks, whether they are facing an opponent or alone. It is not only adult males, but also by adult females and adolescents of both sexes that stomp walk, contrary to sumo strutting and ungulate dominance displays. So, stomp walking and pant huffing may not, in fact, be dominance displays.

The fact that a display is associated with agonistic activity does not prove that the display itself is agonistic. This is illustrated by the exaggerated gait used by sumo wrestlers just prior to a match, the gait for which ursine sumo strutting is named. A naïve observer might jump to the conclusion that this is a dominance display. Actually, it is a religious purification ceremony (Benjamin 2010).

This issue is neither just academic nor semantic, but highly pragmatic. For if pant huffing, woofing, jaw popping or scent marking are labeled as threats, which in the broadest sense include dominance displays, then, any animal making them in the presence of a human might be condemned for daring to threaten a human. Many bears have been killed for no worse crime. Rather than foster such misunderstandings, some biologists prefer referring to these displays as signs of stress (e.g., Herrero et al. 2005).

By far, the most thorough analyzes of bear attacks are those published by Herrero and his colleagues (Herrero 1980, 1985, 2002; Herrero and Higgins 1999, 2003; Herrero et al. 2011). These reports include cases where nonpredatory attacks followed frontal threats; but, no mention is made of attacks that followed a broadside display. Again, predatory attacks were not prefaced by any kind of display.

Geist's statement that an ursine broadside display is a "signal of high danger" is certainly true if "high" refers to severity of injury if the display is followed by attack. However, in all contexts where I have seen it, it indicates low probability of attack. That said, Geist is correct that any dominance display by a bear, either frontal or broadside, warrants extra caution. If the bear is acting offensively (e.g., to usurp the space occupied by people or to steal their food), the people might best leave or dominate the bear by using appropriate body language. A group of viewers often achieves dominance

accidentally just by failing to react, if only out of ignorance that a bear is trying to intimidate them. A lone person can sometimes achieve the same thing by seeming imperturbable. But this takes proverbial nerves of steel and does not always work, in which case one may have to rely on other tactics, such as those detailed by Stringham (2009) or by using pepper spray.

Withdrawal is also 1 option for appeasing a defensive bear (e.g., one defending an animal carcass or protecting small cubs). However, if a person's goal is to observe the bear, a more useful tactic may be to assure the bear that it is in no danger. Viewers commonly appease bears by kneeling, sitting down, or lying down (Figure 1; Stringham 2009). Although a domineering bear can also sometimes be appeased, this should not be done in a manner that rewards its bullying.

Eye contact

Geist emphasizes the importance of maintaining eye contact with any potentially dangerous large mammal. He refers to attacks during a lapse of eye contact when someone thought that a passing ungulate was ignoring them. I earlier described similar experiences with bears. I personally always try to maintain direct eye contact with a domineering bear, but may avert my gaze if the bear is defensive (Stringham 2009). Loss of eye contact also seems to be a factor triggering predatory attacks by cougars (*Puma concolor*) and other large felids (Etling 2001).

Geist notes that dominance displays by ungulates are commonly made with the eyes averted; the opponent is viewed through the rear of the eye. His description does not reveal whether the averted gaze is a consequence of antler or horn orientation. For example, if these weapons are pointed toward an opponent, is the chin necessarily pointed away?

The eyes of a cervid or bovid are oriented somewhat to the side of the head, enabling these animals to see behind themselves. Bears, of course, do not. They cannot watch an opponent if their head is averted much past broadside to the opponent. In that position, the opponent is seen peripherally. The mere fact that a bear averts its eyes is not an indication that it is making a dominance display. On the contrary, this is normally a sign of appeasement in all situations where I have observed bears, except for sumo strutting and stomp walking.

For example, at Wolverine Creek in Alaska, both brown and black bears commonly rest on shore or fish for salmon within 1 to 10 m of several skiffs filled with people. These bears are usually careful to avoid looking directly at people, much in the manner of submissive dogs (Stringham 2008; Figure 6). At sites with fewer visitors, bears commonly investigate people much as they investigate one another, grazing as they move ever closer. If they stare directly at people, they usually do so when alarmed and from distances >50 m.

When a bear is approached by a higher-ranking opponent that makes no weapon threat, the subordinate may turn its head aside (perhaps after sitting back on its haunches), watching the dominant with peripheral vision (Stonorov and Stokes 1972).

So, too, when peaceful bears pass one another, either because they are walking in opposite directions along a trail or because of mutual investigation, they commonly avert their gazes and watch each other peripherally. Averted gaze is especially important when 1 bear runs in the direction of another, perhaps to catch a salmon or to escape an enemy. When a rapidly approaching bear aims its eyes away from another individual (thereby exposing a crescent of whitish sclera of the outside of the closest eye), this can signal that the approaching bear is not threatening the other individual. I am not sure how often bears recognize this distinction, but I have found it reliable in hundreds of cases of a bear walking or running toward me (Stringham 2009). Poulsen (2009) reports that a captive bear uses the direction of its gaze to direct keepers to the focus of its attention, perhaps food or a toy that the bear cannot reach or something that the bear wants removed from its cage.

Deceptive grazing

Geist notes that mountain sheep rams sometimes attack just after grazing up to a rival, as though grazing, like averting its gaze, were a deception that allowed the attacking animal to approach and catch its opponent off guard. By contrast, in thousands of cases of bears feeding near one another, I have never seen grazing immediately precede attack. At most, when the movements of 2 bears bring them uncomfortably close to one another, one may make a short rush (perhaps only 1 or 2 steps)

toward the other bear, which is more likely to retreat than to reciprocate. In other cases, where 2 grazing bears tolerate a mutual approach, they may pass within a few meters of each other without ceasing to feed; or they may raise their heads, walk together, and begin sniffing one another's faces. In the case of adolescents or pre-adolescents, this may eventually lead to mouthing each other's cheeks, then to playful wrestling. Accordingly, when a bear grazes up to me, while watching me peripherally, I interpret this as a sign that it is curious or playful. Cases where the bear just goes through the motions of feeding, seldom biting off vegetation or ingesting it, suggest that the behavior is either a ritualized or insightful means of signaling benign intent, not veiled aggression.

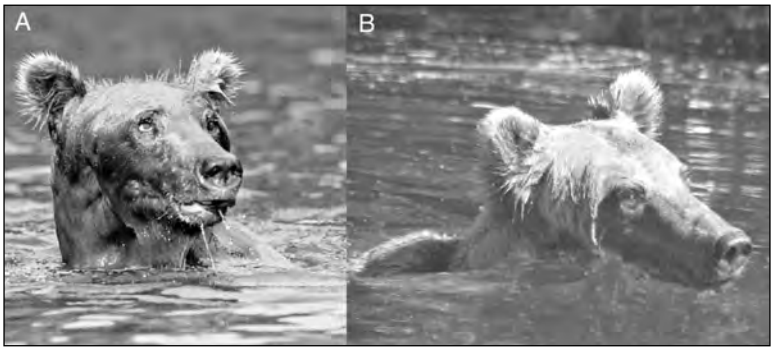

Figure 6. Adult female brown bears fishing for salmon avoided looking directly at boats filled with people a few meters away. In photo B, the bear is watching the people peripherally while facing away from them.

Risk

An unfortunate trait of hazard analysis based on scant information is that one ends up emphasizing the possibility of tragic consequences without being able to quantify their probability even ordinally, much less on an interval scale. Interval analysis also is limited to a narrow range of conditions from which it is difficult to extrapolate. For example, consider Herrero et al.'s (2011) finding that of 36 black bear attacks that killed a person, 92% of the killers were adults or adolescent males. What does that reveal about the relative risk of being injured by male versus female black bears in regions where they are especially shy towards people, perhaps because shy bears have been the most likely to survive hunters? Again, the mere fact that some trait is commonly associated with agonistic or predatory aggression does not mean that it is diagnostic of aggression or even most commonly seen in that context.

Even if one cannot yet quantify how well a display or situation predicts attack, one should be cautious of advising people on the consequences of this vagueness. Any implication that some factor is a good predictor of aggression, when in fact it is rarely followed by aggression, is easily discredited in the public eye. Even if one cannot provide a precise numerical estimate of risk (e.g., 1 attack per 500,000 viewer days), one might provide comparisons with equally severe injury from more familiar hazards (e.g., playing Russian Roulette versus slipping and falling versus driving without a seatbelt fastened).

Through guilt by association, crying wolf can also discredit other warnings and safety recommendations as mere superstitions, as the late Timothy Treadwell and many other viewers, hunters, and anglers have voiced to me. This is but one more example of the constant challenge safety advisors face in trying to protect the public against low frequency but high consequence hazards.

People seldom respect warnings contradicted by their own experience, however limited. One tactic for curbing skepticism is to become much better at identifying the conditions that govern the degree of risk, as Mattson et al. (2011) have done with particular sophistication regarding cougars. For example, what environmental, social, or physiological factors (e.g., stage of the reproductive cycle) might enable an observer to distinguish instances where a broadside display, averted gaze, or grazing represents high attack risk versus negligible risk? Suppose hypothetically that sumo strutting toward a human were followed by attack only 1 in 10,000 times when all cases are considered, but in 10% of those cases where the bear is a previously dominant male who has just lost a fight with another male in competition for an estrus female. The latter generality could be more readily tested than the former. As uncertainty

narrows, credibility rises. The more we know, the more closely management can be tailored to avoid high-risk situations without unduly constraining public freedom to enjoy wildlife and wildlands. For example, in national forests where bears abound, is risk of attack on bicyclists or people walking dogs high enough to warrant managers forbidding those activities?

Conclusions

The intensity of research on body language that characterized early ethology has, unfortunately, waned in the face of newer theoretical priorities. Until recently, few researchers or wildlife managers recognized the pragmatic value of ethological knowledge for people viewing large, potentially dangerous wildlife, much less that viewing would become so popular. At least occasionally, viewer safety may depend critically on being accompanied by a specialist (e.g., interpretive guide or ranger) who understands enough about the behavior of each species to distinguish a wide range of motivations and who knows how to respond appropriately to each. We should not wait until more viewers are mauled before we begin elevating the qualifications of viewing guides and managers to the levels of professionalism long since achieved for hunting guides and managers. Biologists should compile knowledge on behavior of charismatic wildlife into multimedia safety manuals, with elementary versions for casual viewers as well as detailed volumes for professionals (e.g., Stringham 1974, 2002, 2008, 2009; <www.bear-viewing-in-alaska.info>.

Acknowledgments

L. L. Rogers and S. Mansfield (Northwoods Research Center, Ely, Minn.), A. Bryant (Director of the Bear League at Lake Tahoe on the border of California and Nevada), and V. Geist commented on this manuscript and shared unpublished observations. J. Rogers, owner of Katmai Coastal Bear Tours provided transportation to my study sites in Katmai National Park, periodically employed me as a bear viewing guide, and allowed me to study interactions between bears and his (other) guides and clients 1998–2010. Sketches of body postures in Figure 4 are from photos provided by T. Guzzi.

Literature cited

Baker, R. O., and R. M. Timm 1998. Management of conflict between urban coyotes and humans in southern California. Pages 229–312 *in* R. O. Baker and A. C. Crabb, editors. Procceedings of the Vertebrate Pest Conference. University of California, Davis, California, USA.

Benjamin, D. 2010. Sumo: a thinking fan's guide to Japan's national sport. Tuttle, North Clarendon, Vermont, USA.

Bledsoe, W. T. 1987. Brown bear summer: life among Alaska's giants. Dutton, New York, New York, USA.

Burghardt, G. M., and L. S. Burghardt. 1972. Notes on the behavioral development of two female black bear cubs: the first eight months. Ursus 255–273.

Craighead, J. 1972. Comment during a panel discussion on bear behavior. Ursus 2:245.

DeBruyn, T. D., and T. S. Smith. 2009. Managing bear viewing to minimize human impacts on the species in Alaska. Chapter 7 *in* J. Hill, editor. Ashgate Publishing, Farmham, Surrey, United Kingdom.

Egbert, A. L., and A. W. Stokes. 1976. The social behavior of brown bears on an Alaskan salmon stream. Ursus 3:41–56.

Etling, K. 2001. Cougar attacks: encounters of the worst kind. Lyons Press, Gilford, Connecticut, USA.

Ewer, R. F. 1968. Ethology of mammals. Plenum, New York, New York, USA.

Geist, V. 1964. On the rutting behavior of the mountain goat. Journal of Mammology. 45:551–568.

Geist, V. 1972. Comment during a panel discussion on bear behavior. Ursus 2:252.

Geist, V. 1978. Life strategies, human evolution, and environmental design. Springer-Verlag, New York, New York, USA.

Geist, V. 2007*a*. Wildlife habituation: advances in understanding and management application. Appendix B *in* W. N. Graves, editor. Wolves in Russia. Detselig, Alberta, Canada.

Geist, V. 2007*b*. How close is too close? Wildlife professionals grapple with habituating wildlife. Wildlife Professional 2007:34–37.

Geist, V. 2011. Wildlife habituation: advances in understanding and management application. Human–Wildlife Interactions. 5:9–12.

Herrero, S. 1970. Human injury inflicted by grizzly bears. Science 1970:593–598.

Herrero, S. 1972*a*. Aspects of evolution and adap-

tation in American black bears (*Ursus americanus*) and brown and grizzly bears (*U. arctos*). Ursus 2:221–231.

Herrero, S. 1972*b*. Comment during a panel discussion on bear behavior. Ursus 2:247.

Herrero, S. 1983. Social behavior of black bears at a garbage dump in Jasper National Park, Ursus 5:54–70.

Herrero, S. 2002. Bear attacks: their causes and avoidance. Lyons and Buford. New York, New York, USA.

Herrero, S., and A. Higgins 1999. Human injures inflicted by bears in British Columbia 1960–1997. Ursus 11:209–218.

Herrero, S., and A. Higgins 2003. Human injuries inflicted by bears in Alberta 1960–1998. Ursus 14:44–54.

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

Herrero, S., T. Smith, T. D. DeBruyn, K. Gunther, and C. A. Matt. 2005. From the field: brown bear habituation to people—safety, risks and benefits. Wildlife Society Bulletin 33:362–373.

Jans, N. 2005. The grizzly maze: Tim Treadwell's fatal obsession with Alaskan bears. Dutton, New York, New York, USA.

Jordan, R. H. 1976. Threat behavior of the black bear (*Ursus americanus*). Ursus 3:57–63.

Jordan, R. H., and G. M. Burghardt. 1986. Employing an ethogram to detect reactivity of black bears (*Ursus americanus*) to the presence of humans. Ethology 73:89–115.

Kilham, B., and E. Gray. Among the bears: raising orphaned cubs in the wild. Holt, New York, New York, USA.

Leslie, R. F. 1968. The bears and I. E.P. Dutton, New York, New York, USA.

Lorenz, K. 1966. On aggression. Bantam, New York, New York, USA.

Ludlow, J. C. 1976. Observations on the breeding of captive black bears. Ursus 3:65–69.

Mosolov, V., and T. Gordienko. 2004. In memory of Vitaly Nikolayenko—his 33rd field season. International Bear News 13:6.

Pezzenti, J. 2001. Shooting bears: the adventures of a wildlife photographer. Rizzoli, New York, New York, USA.

Pruitt, C. H. 1976. Play and agonistic behavior in captive black bears. Ursus 3:79–86.

Pruitt, C. H, and G. M. Burghardt. 1977. Communication in terrestrial carnivores: mustelidae, procyonidae, and ursidae. Pages 767–793 *in* T.A. Sebeok, editor. How animals communicate. Indiana Univiversity Press, Bloomington, Indiana, USA.

Poulsen, E. 2009. Smiling bears: a zookeeper explores the behavior and emotional life of bears. Greystone, Vancouver, British Columbia, Canada.

Russell, R. 1972. Comment during a panel discussion on bear behavior. Ursus 2:248.

Shelton, J. G. 2001. Bear attacks II: myth and reality. Pallister, Hagensborg, British Columbia, Canada.

Smith, T. S., S. Herrero, C. S. Layton, R. Larsen and K. R. Johnson. (in press). Efficacy of firearms for bear deterrence in Alaska. Journal of Wildlife Management.

Stringham, S. F. 1974. Mother–offspring relations in moose. Naturaliste Canada 101:325–369.

Stringham, S. F. 2002. Beauty within the beast. Seven Locks Press, Santa Anna, California, USA.

Stringham, S. F. 2007. Bear viewing in Alaska. Falcon Press, Helena, Montana, USA.

Stringham, S. F. 2008. Alaska magnum bear safety manual. WildWatch, Soldotna, Alaska, USA.

Stringham, S. F. 2009. When bears whisper, do you listen? WildWatch, Soldotna, Alaska.

Walther, F. R. 1984. Communication and expression in hoofed mammals. Indiana University Press, Bloomington, Indiana, USA.

STEPHEN F. STRINGHAM is an adjunct professor at the University of Alaska–Anchorage, director of the Bear Viewing Association, and president of WildWatch, a consulting and research firm. He has studied communication, aggression, and human–wildlife interactions with bears and ungulates since 1969. His broader interests include the role of cognitive innovation in adaptation by wildlife to changing environments. (*Photo courtesy K. Fredriksson)*