A proposed lexicon of terms and concepts for human–bear management in North America

John B. Hopkins III[1,6], Stephen Herrero[2], Richard T. Shideler[3], Kerry A. Gunther[4], Charles C. Schwartz[5], and Steven T. Kalinowski[1]

[1]*Department of Ecology, Montana State University, Bozeman, MT 59717-3460, USA*
[2]*Faculty of Environmental Design, Environmental Sciences Program, University of Calgary, Calgary, AB T2T 2Y2, Canada*
[3]*Alaska Department of Fish and Game, Wildlife Conservation Division, 1300 College Road, Fairbanks, AK 99701, USA*
[4]*Bear Management Office, Yellowstone National Park, PO Box 168, WY 82190, USA*
[5]*Northern Rocky Mountain Science Center, Interagency Grizzly Bear Study Team, 2327 University Way, Bozeman, MT 59717, USA*

Abstract: We believe that communication within and among agency personnel in the United States and Canada about the successes and failures of their human–bear (Ursidae) management programs will increase the effectiveness of these programs and of bear research. To communicate more effectively, we suggest agencies clearly define terms and concepts used in human–bear management and use them in a consistent manner. We constructed a human–bear management lexicon of terms and concepts using a modified Delphi method to provide a resource that facilitates more effective communication among human–bear management agencies. Specifically, we defined 40 terms and concepts in human–bear management and suggest definitions based on discussions with 13 other professionals from the United States and Canada. Although new terms and concepts will emerge in the future and definitions will evolve as we learn more about bear behavior and ecology, our purpose is to suggest working definitions for terms and concepts to help guide human–bear management and research activities in North America. Applications or revisions of these definitions may be useful outside of North America.

Key words: bear incidents, definitions, food conditioning, habituation, human–bear conflict, human–bear interactions, human–bear management, *Ursus americanus*, *Ursus arctos*, *Ursus maritimus*

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Bear (Ursidae) population management includes four main objectives: conservation, sustained yield harvest, predator or depredation control (Miller 1990), and human–bear management (Fig. 1). Although methods to achieve these goals discussed by Miller (1996) may vary within and among agencies, management programs often use similar strategies to meet their objectives. In contrast, the strategies used by agencies to manage bear incidents can vary greatly.

Over the past several decades, human–bear management strategies evolved throughout the United States and Canada as proactive management methods emerged to face challenges of mitigating bear incidents (Witmer and Whittaker 2001). This evolution in management resulted in divergent strategies (site- and agency-specific) despite common program goals to prevent bear incidents. Because various human–bear management methods and strategies are used throughout the United States and Canada, we believe it is important for agencies to share information about program successes and failures to learn what methods and strategies are effective.

Currently, there are numerous terms and concepts used in human–bear management; however, some programs have different definitions for the same terms and concepts. We suggest agencies clearly define the terms and concepts they use in their programs (Whittaker and Knight 1998) and use them in a consistent manner. We also feel a common human–bear management language would improve communication among human–bear management professionals in the United States and Canada and may be applicable to human–bear management programs worldwide.

[6]jbhopkins3@gmail.com

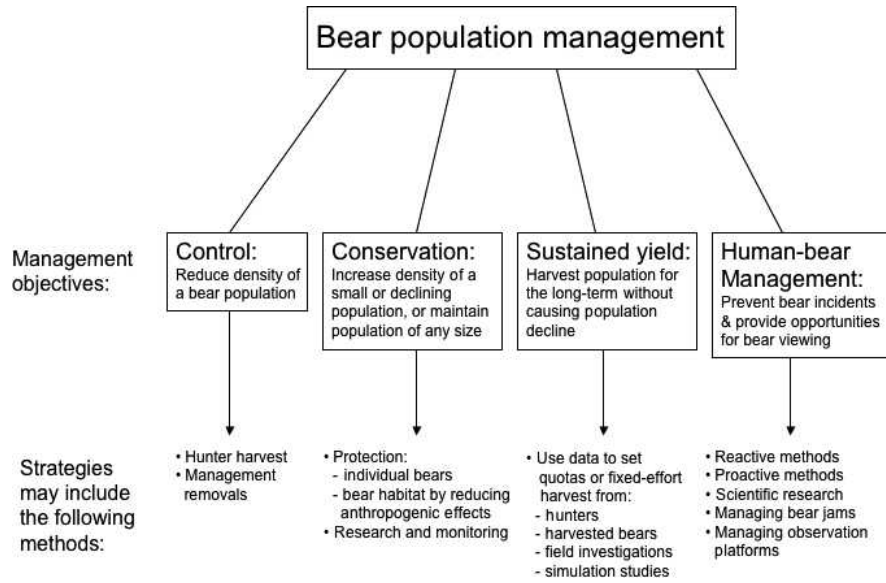

Fig. 1. The four bear population management objectives and examples of their strategies and methods.

Standardized definitions for terms and concepts could benefit human–bear management programs in three ways. First, they would enhance site-specific and intra-agency bear conservation efforts. For example, Yellowstone (Gunther et al. 2004), Glacier (Gniadek and Kendall 1998), Yosemite (V. Seher, Yosemite National Park, California, USA, personal communication, 2009), and several Alaskan national parks (Wilder et al. 2007) developed human–bear management databases. Although each database contains similar information, terminology and definitions for the data differ. If the U.S. National Park Service (NPS) adopted the same terms and definitions and collected the same data, an intra-agency meta-analysis could be conducted. Such an analysis would benefit each park and could provide insight regarding the successes and failures of human–bear management programs throughout the NPS, facilitating a general NPS management strategy.

Second, universal definitions would also promote interagency bear conservation efforts. For example, in the Greater Yellowstone Ecosystem (GYE), records of bear incidents prior to 1992 varied in level of detail, criteria, and definition, depending on which of the 13 state and federal land management agencies had jurisdiction over the site where the incident occurred (Gunther et al. 2004). Consequently, these inconsistencies contributed to delayed prediction, evaluation, correction, and prevention of incidents between humans and grizzly bears (*Ursus arctos*) in the GYE.

Lastly, a common language would benefit human–bear management by defining terms and concepts to researchers who study and evaluate these methods and programs. Definitions would be useful to researchers when designing projects, documenting and discussing study results, and making recommendations.

Here, we propose working definitions for terms and concepts currently used in human–bear management and research. We understand that new terms and concepts will need to be addressed as they emerge in the future, and that definitions for terms and concepts will evolve as we learn more about bear behavior and ecology. The main purpose of this paper, however, is to provide bear population management programs a resource to help guide their human–bear management and research activities.

Methods

We constructed the lexicon in two stages. First, we reviewed peer-reviewed and unpublished human–bear management literature from the United States and Canada and assembled a list of commonly used management terms. We then either extracted or inferred definitions for these terms from the literature, or constructed new definitions for these terms.

In addition, we developed and defined terms and concepts that are not common in the literature, but that we believe are important to human–bear management. Each term defined in the lexicon (Table 1) is italicized the first time it is described in Discussion.

Next, we asked 25 professionals (federal, state, or provincial managers, researchers, and a private consultant) engaged in human–bear management and research in the United States and Canada to review the lexicon and the original manuscript. We used a modified Delphi method (Linstone and Turoff 1975) to incorporate professional opinions in defining terms and concepts. Specifically, we reviewed comments, addressed remarks by correspondence, and modified the lexicon until there was consensus among co-authors.

Results

In addition to co-authors, a total of 13 professionals (see Acknowledgements) reviewed the original manuscript and 40 human–bear management terms and concepts were defined (Table 1), and discussed in four sections. We used Fig. 1 and Fig. 2 to describe bear population management objectives, strategies, and methods as well as illustrate the management status of bears, respectively. We also developed a flow chart (Fig. 3) and dichotomous key (Table 2) to assist managers with documenting bear sightings and bear incidents.

Discussion

Human–bear management strategies

The focus of bear population management in the United States and Canada has evolved over more than 100 years as the perception and extrinsic value of bears has changed. In the late 19th and early 20th centuries, bears were considered vermin, and bear population management reduced or eliminated bears from large regions (Miller 1990, Schwartz et al. 2003). By the 1920s, bears were classified as game animals in many areas throughout the United States and Canada, which ultimately restricted indiscriminate killing and set the stage for modern bear harvest management (Miller 1990). Currently, a common goal of bear population management is to ensure the long-term viability of the species. Most bear population management plans include a program to address the human role in bear management. Adding the word human to bear management (*human–bear management*) reflects an increasing focus in bear population management: to mitigate bear incidents, and in some cases, to provide people with opportunities for enjoying bears through managed viewing (Fig. 1).

Human–bear management uses one or more of the following management strategies: reactive, proactive, and adaptive management. *Reactive human–bear management* is a strategy that responds to individual bears involved in bear incidents through immediate and direct action (Thompson and McCurdy 1995), or increases the harvest of a local population of bears in an attempt to reduce bear incidents. The goal of reactive management is to prevent future conflicts or other incidents with specific bears, or to reduce the local population if a specific individual cannot be identified. Under this strategy, management staff generally deal with bears on a case-by-case basis. Reactive human–bear management includes, but is not limited to, the following management methods: capture (often including immobilization, handling, and marking bears), monitoring, management removal (lethal or non-lethal), translocation, relocation, on-site release, hazing, aversive conditioning treatments, and closing areas to human access (and posting warning signs, or both) where there have been human–bear conflicts.

Proactive human–bear management is a population-level management strategy that aims to deter or prevent individual bears not previously or currently involved in bear incidents from being involved in incidents. This often involves the application of management measures to people and human-use areas where conflicts and other bear incidents occurred or may occur. Proactive methods such as management of edible waste, implementing food storage regulations, exclusion (e.g., fencing), public education, closing bear management areas, and other techniques are now common in human–bear management programs in the United States and Canada.

Implementing preventative methods has reduced the amount of human injury, bear removals and translocations, and incidents of bears obtaining *anthropogenic food* (e.g., agricultural and garden crops, barbeque grill scraps, compost, fish from hatcheries, fruit from orchards or vineyards, grease and lubricants, honey from apiaries, *human food*, hunter-killed carcasses, livestock or pets, pet food or birdseed, sanitary waste, trash) and incidents of

Table 1. Lexicon of terms and concepts for human–bear management. Italicized terms are included in the lexicon.

Definitions for terms and concepts
aggressive behavior: bear behavior (defensive or offensive) that is threatening to people
aggressive bear: a bear that has displayed *aggressive behavior* and is a public safety concern
defensive-aggressive bear: a bear that may be a public safety concern because it exhibited *aggressive behavior* in response to being *provoked*
offensive-aggressive bear: a bear that may be a public safety concern because evidence suggests the bear exhibited aggressive behavior and was not provoked
anthropogenic food: foods or attractants having a human origin
aversive conditioning: a learning process in which deterrents are continually and consistently administered to a bear to reduce the frequency of an undesirable behavior
aversive conditioning treatment (or trial): a management method that attempts to use the *aversive conditioning* learning process to modify bear behavior for the long-term
bear attack: intentional contact by a bear resulting in human injury (verbatim from Smith et al. 2005)
bear deterrent: aversive agent administered to bears to cause pain, avoidance, or irritation
bear incident: an occurrence that involved a *human–bear conflict* or episodes where bears caused property damage, obtained anthropogenic food, killed or attempted to kill livestock or pets, or were involved in vehicle collisions (Gunther 1994, Schirokauer and Boyd 1998, Gunther et al. 2004, Wilder et al. 2007)
bear jam: an instance when people slow or stop their vehicles to view or photograph bears, causing traffic congestion (Gunther and Biel 1999)
bear sighting: an observation when a bear was seemingly unaware of the person observing it (not a *human–bear interaction*), had no observable stress-related response to the person during an *interaction* (Smith et al. 2005, Wilder et al. 2007), or responded to the person (who did not take extreme *evasive action*) by taking *evasive action*
bear that tolerates people: a bear that does not take *evasive* or *aggressive* action when in the presence of people (*habituated* or innately tolerant)
conditioning: learning involved in receiving a reward or punishment for a given response (behavioral act) to a given stimulus (verbatim from McCullough 1982)
evasive action of bears or humans: when a bear or person responds to a *human–bear interaction* by escape or avoidance
food-conditioned bear: a bear that has learned to associate people (or the smell of people), human activities, human-use areas, or food storage receptacles with *anthropogenic food* (Herrero et al. 2005)
habituation: the waning of a response (or muted response) when a reward or punishment is discontinued (verbatim from McCullough 1982)
habituated bear: a bear that shows little to no *overt reaction* to people (Herrero et al. 2005) as a result of being repeatedly exposed to anthropogenic stimuli without substantial consequence
hard release: a hazing method where *deterrents* are administered to a bear as it exits a trap
hazing: a technique where *deterrents* are administered to a bear to immediately modify the bear's undesirable behavior (Schirokauer and Boyd 1998)
human–bear conflict: when a bear exhibited stress-related or curious behavior, causing a person to take extreme evasive action (Schirokauer and Boyd 1998), made physical contact with a person or exhibited clear predatory behavior, or was intentionally harmed or killed (not including legal harvests) by a person
human food: *anthropogenic foods* that only include human foodstuff and food waste
human–bear interaction: an occurrence when a person and bear are mutually aware of each other (Smith et al. 2005)
human–bear management: a bear population management program that focuses on mitigating *bear incidents* and providing bear viewing opportunities
management bear: a bear that may be monitored for management purposes because it is individually identifiable
management closure: when management staff restrict or prevent human access to an area because of the increased potential for *human–bear conflict*
management removal: lethal or non-lethal removal of a bear from the population by or at the direction of management personnel
management status: a classification assigned to each management bear of *habituated* (not food-conditioned), *food-conditioned* (not habituated), habituated and food-conditioned, *aggressive*, *predatory*, *unknown*, or *unmanaged*
on-site release: a management method that consists of capturing and releasing a bear at the site of capture (Gunther et al. 2000, Clark et al. 2002)
overt reaction distance (ORD): the distance at which a bear visibly responds to people (Herrero et al. 2005) during a *human–bear interaction*
predatory bear: a bear that preyed or attempted to prey on people (Herrero and Higgins 2003)
proactive human–bear management: a population-level management strategy that aims to deter or prevent individual bears not previously or currently involved in *bear incidents* from being involved in incidents
problem bear: a bear involved in repeated *bear incidents*
provoked bear: when a person enters a bear's *ORD*
reactive human–bear management: a management strategy that responds to individual bears involved in *bear incidents* through immediate and direct action (Thompson and McCurdy 1995) or increases the harvest of a local population of bears in an attempt to reduce bear incidents

Table 1. Continued.

Definitions for terms and concepts
relocation: the capture and subsequent transport of a bear from the site of capture to a location within its likely home range often in an attempt to temporarily mitigate *bear incidents*
stress-related behaviors: observed bear response when provoked during a *human–bear interaction* (Herrero et al. 2005)
translocation: the capture and subsequent transport of a bear from the site of capture to a location outside its presumed home range often in an attempt to permanently mitigate *bear incidents* or augment a population
unknown bear: a bear that has an unknown management status and will be monitored in the future
unmanaged bear: a bear that will not be monitored in the foreseeable future because it has not been observed interacting with people or suspected of being involved in any *bear incidents*

property damage (Herrero 1985, Gunther 1994, Thompson and McCurdy 1995, Gniadek and Kendall 1998, Honeyman 2008; L.M. Ciarniello, 1997, Reducing bear–human conflicts: Solutions through better management of non-natural foods, Westworth, Brusnyk and Associates, Edmonton, Alberta, Canada). Although we realize that preventing an individual bear from being involved in an incident may seem proactive, we believe that responding to any individual bear should be considered reactive human–bear management.

Implementing reactive and proactive human–bear management allows managers to prevent or reduce conflict as well as respond to incidents as they occur. The choice of various combinations of proactive and reactive management methods is often based on a manager's qualitative analysis of past experiences

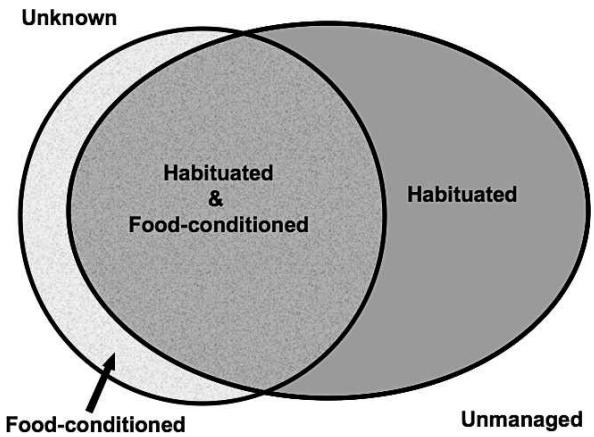

Fig. 2. Venn diagram illustrating the management status of bears: food-conditioned (not habituated), habituated (not food-conditioned), habituated and food-conditioned, unknown, unmanaged. The management status aggressive bear and predatory bear are not included in the diagram, but may be designated simultaneously or following assignment to a classification.

(KAG, unpublished data) and is not typically based on data collected to answer a particular management-related question. Although managers' decisions often result in fewer human–bear incidents, the effectiveness or success of each method is often unclear because they are not scientifically evaluated.

Research is used to evaluate current management methods and program success, justify the use of new untested methods, predict the efficacy of future strategies, and investigate bear ecology. A dynamic management strategy, which adjusts according to new information from management and research, is referred to as adaptive management (Walters 1986). Adaptive human–bear management typically employs both reactive and proactive management methods, and we believe is the most effective human–bear management strategy because management direction shifts according to previous successes, failures, and research findings.

Management methods

A *management removal* is the lethal or non-lethal removal of a bear from the population by, or at the direction of, management personnel. Non-lethal removals include sending bears to zoos, rehabilitation facilities, or other ecosystems, whereas lethal removals involve intentionally or unintentionally killing bears during management actions (Gunther 1994). Examples of management removals include killing predatory or aggressive bears or augmenting another population.

Following Ciarniello (unpublished report 1997), we propose defining *translocation* as the capture and subsequent transport of a bear from the site of capture to a location outside its presumed home range (often a remote area) in an attempt to permanently mitigate bear incidents or augment a population. The term *relocation* is often used synonymously (Landriault et al. 2009); however,

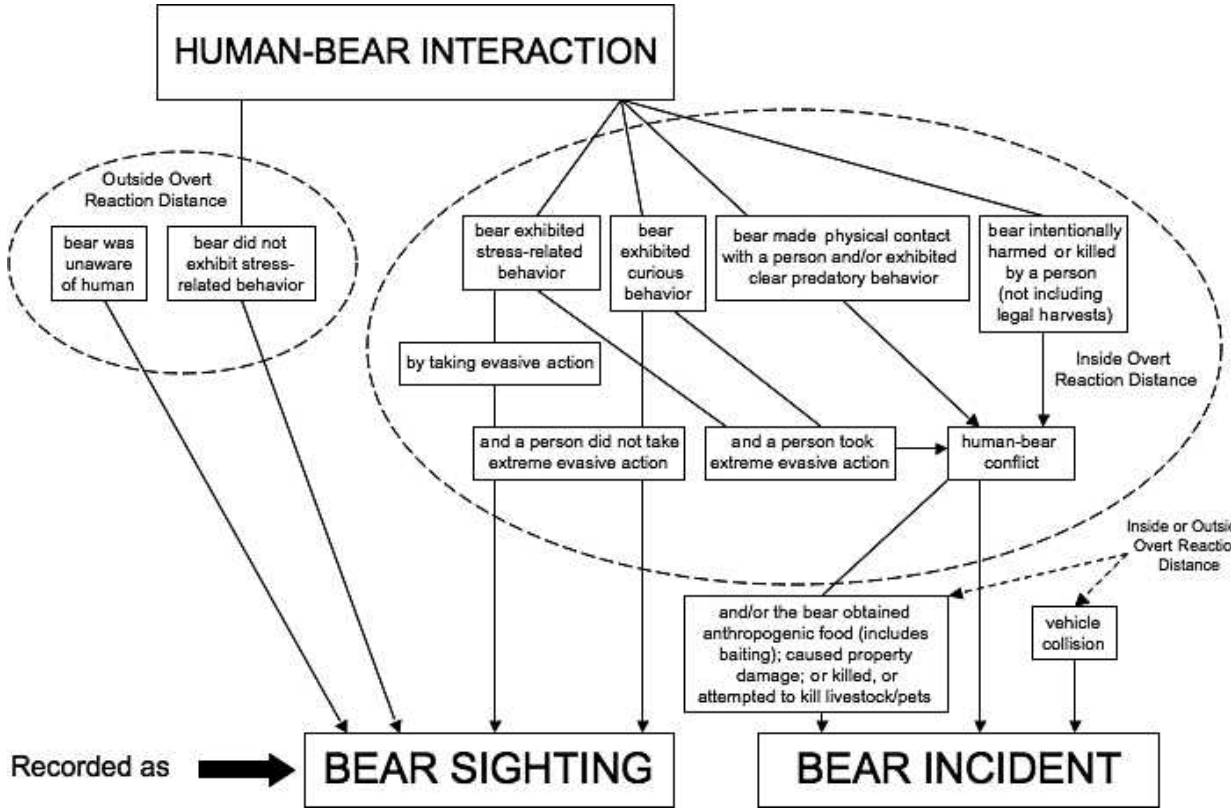

Fig. 3. Flow chart illustrating whether a human–bear interaction or other episode involving a bear should be documented as a bear sighting or bear incident given the suggested definitions for these terms.

we propose defining relocation as moving a bear within its likely home range (often in an attempt to temporarily mitigate bear incidents). Unlike relocated bears, translocated bears are transported to sites outside their home ranges to increase the probability that the individual will establish a home range elsewhere and not return to the capture area. Although some agencies continue to perform this reactive management method, many have discontinued translocations because most such bears return to the capture area (Miller and Ballard 1982, Knight et al. 1988, Meagher and Fowler 1989, Blanchard and Knight 1995, Beckmann and Lackey 2004). However, relocations are used in some situations where short-term removal from an immediate conflict situation may eliminate the conflict over a longer period. Relocation of polar bears (*U. maritimus*) from Churchill, Manitoba to remote areas near the forming sea ice has been successful in reducing incidents (D. Hedman, Manitoba Conservation,

Table 2. Dichotomous key to determine whether a human–bear interaction should be documented as a bear sighting or bear incident.

Question	Response
1. Did the bear make physical contact with you or did you intentionally harm or kill the bear?	yes, document as a *incident* no, go to question 2
2. Did the bear act as if it was aware of you?	yes, go to question 3 no, document as a *sighting*
3. Did you take extreme evasive action (e.g. ran away, climbed a tree, played dead, fired bear deterrent spray, discharged ammunition from a firearm) in response to feeling threatened by the bear's behavior?	yes, document as a *incident* no, document as a *sighting*

Thompson, Manitoba, Canada, personal communication, 2009). Likewise, Parks Canada relocated grizzly bears and American black bears (*U. americanus*) (H. Morrison, Parks Canada, Field, British Columbia, Canada, personal communication, 2009) and Montana Fish, Wildlife, and Parks relocated grizzly bears (M. Madel, Montana Fish, Wildlife and Parks, Great Falls, Montana, personal communication, 2009) that were observed near human-use areas. These grizzly and black bears were moved to locations where natural foods were abundant as a short-term measure to reduce conflicts.

An *on-site release* consists of capturing—and in some cases immobilizing, handling, and marking—and releasing a bear at the site of capture (Gunther et al. 2000, Clark et al. 2002). Capturing and handling bears may provide individual bears a negative stimulus, reinforcing its avoidance of people and deterring it from returning to areas where is was captured (Brady and Maehr 1982; Wooding et al. 1988; Shull 1994; Clark 1999; Clark et al. 2002, 2003). Therefore, under certain circumstances, an on-site release could be used as a form of hazing, but is not a form of translocation or relocation because the bear is not transported from the capture site. A *hard release* (in a hazing context) is a method where *bear deterrents*—defined as aversive agents administered to bears to cause pain, avoidance, or irritation (e.g., projectiles such as rubber buckshot, batons, bean bags)—are administered to a bear as it exits a trap (Beckmann et al. 2004; Brabyn, N., L. Homstol, and T. Hamilton. 2005, Unpublished progress report 2005. Whistler black bear aversive conditioning and monitoring project. Whistler, British Columbia, Canada).

Hazing is a technique where deterrents are administered (independently, simultaneously, or consecutively) to a bear to immediately modify the bear's undesirable behavior (e.g., bear entering a campground; Schirokauer and Boyd 1998). Hazing is usually not intended to alter undesirable bear behavior for the long-term. Instead, it is the primary reactive management technique to disperse management bears from human-use areas on a case-by-case basis. Hazing may, however, prove effective at modifying undesirable behavior of unmanaged bears or of bears that are in the initial stages of food conditioning (Mazur 2010). Hazing is also currently used to describe the action of applying deterrents to bears during aversive conditioning treatments (Hunt 2003, Honeyman 2008, Mazur 2010) and should not be confused with the learning process, aversive conditioning.

Aversive conditioning of bears is a learning process in which deterrents are continually and consistently administered to a bear to reduce the frequency of an undesirable behavior (Brush 1971, McCullough 1982). An *aversive conditioning treatment* (*or trial*) is a management method that attempts to use the aversive conditioning learning process to modify undesirable bear behavior for the long-term. Many studies investigated aversive conditioning of bears by examining the effects on bears that have undergone aversive conditioning treatments in a natural setting (e.g., Gillin et al. 1994, Ternent and Garshelis 1999, Beckmann et al. 2004, Leigh and Chamberlain 2008, Mazur 2010). In some aversive conditioning studies, bears were not continually monitored during treatments, which may have led to inconsistent reinforcement. A pilot study in Yosemite National Park investigated the effects of aversive conditioning treatments on black bears by continually and consistently administering deterrents to them. This was achieved by applying deterrents to 4 highly habituated and food-conditioned bears nearly every time they approached a human-use area, for an average of 168 consecutive hours/treatment. Findings suggested that these aversive conditioning treatments were unsuccessful at deterring highly food-conditioned bears from approaching human-use areas (V. Seher, Yosemite National Park, California, unpublished data, 2005). Many human–bear management programs haze bears routinely, but few programs continually and consistently apply deterrents to bears so that aversive conditioning has occurred.

A *management closure* restricts or prevents human access to an area because of increased potential for human–bear conflict. Typically areas are closed by management personnel reactively in response to human conflict with aggressive bears, female grizzly bears with cubs, injured bears, or bears guarding a carcass. Management closures are also used to reduce the likelihood of conflict due to the availability of high-quality food sources (e.g., ungulate or livestock carcasses, spawning streams, calving areas, ungulate winter ranges, berry patches). For example, Yellowstone National Park closes rental cabins, campgrounds, and backcountry trails and campsites in areas containing high quality bear foods. These proactive seasonal management closures are designed to (1) minimize human–bear interactions that may lead to habituation of bears to people, (2)

prevent human-caused displacement of bears from prime food sources, and (3) decrease the risk of bear-inflicted human injury in areas with high levels of bear activity (Gunther 1994). Denali National Park, Alaska closes one of their campgrounds when moose (*Alces alces*) calve in or near the campground and attract grizzly bears. Once calving is over, the campground is re-opened (RTS, unpublished data).

Management status

A *management bear* is a bear that may be monitored for management purposes because it is individually identifiable (i.e., with a visual tag, radio-collar, lip tattoo, microchip, or a distinct morphological characteristic). Management bears are often involved in bear incidents or are sighted regularly, typically captured in human-use areas, and may have a known or unknown management status. A bear's *management status* is a classification assigned to each management bear: (1) habituated (not food-conditioned), (2) food-conditioned (not habituated), (3) habituated and food-conditioned, (4) aggressive, (5) predatory, (6) unknown, or (7) unmanaged (Fig. 2).

Habituation and conditioning. Habituation and conditioning are commonly but erroneously used interchangeably, and may be the two most complex and misapplied terms in human–bear management. According to McCullough (1982:28), who summarized the concepts of learning behavior and applied them to bear behavior, *habituation* "is the waning of a response [or muted response] (whether learned by conditioning or otherwise) when a reward or punishment is discontinued. It is not the learning or formation of a habit as it is sometimes appears in the wildlife literature," and *conditioning* "is learning involved in receiving a reward or punishment for a given response (behavioral act) to a given stimulus." We believe these terms are often confused when applied to human–bear management because the process of human food conditioning can lead to rapid habituation, and the process of habituation may lead to more opportunities for bears to become positively conditioned by human food rewards.

Habituated bear. We define a *habituated bear* as a bear that shows little to no overt reaction to people (Herrero et al. 2005) as a result of being repeatedly exposed to anthropogenic stimuli (e.g., people, human scent, human structures) without substantial consequence. The lack of an overt reaction from a bear may be a mild response by the bear but not detectable to observers.

Herrero et al. (2005) and Smith et al. (2005) examined the complexities of the behavioral response habituation, using the term *overt reaction distance* (ORD) to describe the distance at which a bear visibly responds to people during a human–bear interaction (Herrero et al. 2005). A bear's behavioral response may vary from being undetected (e.g., salivating and posturing), to mild (e.g., cessation of feeding or looking at the source of the stimulus), to obviously stress-related. Examples of *stress-related behaviors* include fleeing the area, climbing a tree, intense staring, bluff-charging, jaw or lip-popping, front leg stomping, standing on hind legs, loud vocalizations (e.g., huffing, woofing, growling, gulping, moaning), and defensive non-predatory *attack* (Herrero et al. 2005). Correct interpretation of these behaviors depends on a broader understanding of the context of the interaction. For instance, a bear approaching or circling may be displaying signs of curiosity or predatory behavior, and may not be stress-related.

In addition to habituation, there are many factors that can influence the distance at which bears tolerate people. These include human-related factors (e.g., person's activity at time of encounter, group size, person's behavior in response to encountering a bear), environment-related factors (e.g., season, time, presence of conspecifics), and bear-related factors (e.g., species, sex–age class, previous experience with people; Herrero et al. 2005). Therefore, each individual bear's ORD varies depending on the factors involved in the human–bear interaction.

There is considerable confusion between the terms tolerance and habituation. Nisbet (2000:315) defines tolerance as "the intensity of disturbance that an individual tolerates without responding in a defined way." We believe a *bear that tolerates people* does not take evasive or aggressive action when in the presence of people. Smith et al. (2005) stated that confusion often arises because both bears habituated to people and bears innately tolerant of people (i.e., not learned) have little to no response when close to people. To clarify, habituated bears are tolerant of people to some degree; however, some bears that are tolerant of people may not have undergone the learning process of habituation (pathways of habituation described below) but instead may be inherently tolerant of people. Tolerant bears have shorter ORDs than intolerant or non-habituated bears.

Smith et al. (2005) distinguished between three types of habituation: bear-to-bear, bear-to-human, and human-to-bear. Bear-to-bear habituation usually occurs when bears frequently interact (e.g., aggregations of bears feeding on salmon [*Oncorhynchus* spp.] in spawning streams, or at a garbage dump; Egbert 1978, Jope 1983, Craighead et al. 1995). As a result, bears in these situations have very short ORDs with each other, which may lead to increased habituation to people (Herrero et al. 2005). Bear-to-human habituation occurs when bears tolerate the presence of people as a result of frequent and benign contact (McCullough 1982; Jope 1983, 1985; Smith et al. 2005). For example, bear-to-human habituation may take place in areas such as Yellowstone National Park, where bear density is relatively low and human visitation is high. Although Jope (1985) found that habituated bears were less likely to injure people than non-habituated bears, increased human use in bear habitat leads to more frequent (and potentially dangerous) interactions between people and bears and may increase the tolerance bears have for people, decreasing their ORDs (Jope 1983, Herrero et al. 2005, KAG unpublished data). Alternatively, Smith et al. (2005) considered that bear-to-human habituation is more common in high-density bear areas where bear-to-bear habituation is high. Bear-to-bear and bear-to-human habituation results in bears expending less energy reacting to people, therefore benefiting bears by allowing individuals to adapt to local circumstances (Jope 1983, Smith et al. 2005). The final type of habituation, human-to-bear, occurs when human avoidance response declines as a result of bears not reacting aggressively (offensive or defensive) when close to people. This type of habituation is a concern because people become increasingly casual around bears (e.g., viewing bear on salmon spawning streams in Alaska), increasing the potential for human–bear conflict (Schullery 2001, Smith et al. 2005).

The process of habituation is one of the most important influences on bears' ORDs (Smith et al. 2005), but a more complete understanding of habituation must also incorporate other factors influencing ORD (Herrero et al. 2005). Although we recognize that bears habituated to people and bears innately tolerant of people exhibit similar behaviors, and that the pathways and factors involved in their tolerance of people are difficult to determine, we proposed our modified definition of a habituated bear (see beginning of section). When managing individual bears, we suggest that managers consider (1) the potential pathways that led to the bear's habituation (i.e., bear-to-bear or bear-to-human), (2) factors influencing a bear's ORD, and (3) that the observed bear may be tolerant of people and not habituated.

For example, imagine that a bear initially classified as habituated is reported at a roadside viewing area. When management personnel arrive, they observe the bear near people (therefore tolerating them to a certain degree) at the parking lot bathroom. When approached to 25 meters, the bear escapes into the timber. A few days later, they see the bear has entered the bathroom, and in response, they haze the bear from the area using various deterrents. Following the incident, they inspect the bathroom and find a non-bear-proof garbage can inside and learn the door does not close properly; they suspect the bear received a human food reward during a previous visit. A day later, the can is removed, the door is fixed, and the pullout is closed for 2 weeks to mitigate the potential for conflict. After a week of observing the bear near the bathroom, the bear is never seen again. Staff determined the primary factor influencing the bear's ORD was the non-bear-proof garbage can in the bathroom. For this case study, we believe the bear was tolerant of people and in the process of being food conditioned, which likely led to the animal's bear–human habituation.

We provide another scenario to illustrate bear tolerance. Two fishermen were fishing for salmon on a remote section of river in Alaska. After a few hours of fishing, a large bear emerged from the willows (*Salix* spp.) 25 meters away and startled the anglers. In response to their presence, the bear ambled downstream 50 meters and began fishing for salmon in the middle of the river. As a result of this benign interaction, the fishermen continued to fish in the same area while also viewing the bear. Although it is unknown if the bear was tolerant of the fisherman due to previous interactions with humans or other bears, the animal should be described as having tolerance for people and classified as an unmanaged bear.

Habituation often occurs in human-use areas that contain high-quality bear foods. For example, some bears in the Rocky Mountain national parks of Canada and U.S. have learned to graze on the green vegetation adjacent to roads, ignoring nearby traffic and onlookers. In this case, habituation may extend the available feeding habitat and allow bears to use

habitat otherwise not available. Because habituated bears are often near people when using these habitats, their potential to be exposed to human food is higher than that of conspecifics that use more remote areas. A habituated bear in a human-use area is often the greatest management concern because of the individual's susceptibility to becoming food-conditioned. As a result, it is often advisable to monitor and manage people in human-use areas or haze such bears from these areas.

Clearly, further research on habituation is needed to advance the term's use. Nisbet (2000), in reference to colonial waterbirds, suggested such study would require the examination of repeated measures of response on individuals subjected to controlled repetition of the same stimulus. Until research results can provide new insight on how to classify habituated bears, we suggest using the modified Herrero et al. (2005) definition for this complex term.

Food-conditioned bear. A *food-conditioned bear* has learned to associate people (or the smell of people), human activities, human-use areas, or food storage receptacles (e.g., bear-lockers, trashcans, dumpsters, backpacks, vehicles) with anthropogenic food (Herrero et al. 2005).

Food-conditioned bears have varying levels of food-conditioned behavior, and as a result some individuals are more tolerant of people than others. The level to which a bear is food-conditioned seems to be associated with factors such as natural and anthropogenic food availability (Mattson 1990, Gunther et al. 2004), natural tolerance of people (Mattson 1990, Herrero et al. 2005, Smith et al. 2005), and perhaps reproductive status (Clark et al. 2002). For instance, a bear that patrols campgrounds from spring through fall, receives food rewards on a daily basis, and continues food-conditioned behavior when repeatedly hazed is an example of a highly food-conditioned bear. Alternatively, a bear that only scavenges human food in a few unoccupied campsites at night, during a season when natural foods are scarce, is an example of a bear that has a low level of food-conditioned behavior.

Although many food-conditioned bears are also habituated to people, there is evidence suggesting bears can be food-conditioned but not habituated. In Yellowstone and Great Smoky Mountains national parks, there have been reports and observations of bears routinely entering empty campsites at night to scavenge human food discarded during the day. The observations suggest that these bears are food-conditioned but not habituated because they purposefully scour the campsite for food when people are absent, presumably to reduce the chance of conflict. Following each episode, the bears leave evidence (digging in campfire rings, tracks, or scats in camp), but are rarely observed (KAG, unpublished data; E.K. DeLozier, Smoky Mountains National Park, Gatlinburg, Tennessee, personal communication, 2009). In addition, bears that consume some agricultural foods (e.g., corn, apples, livestock) may not be tolerant of people or interested in seeking out food around human habitations.

Classifying a bear as food-conditioned or habituated. We believe a source of confusion for classifying bears as food-conditioned or habituated stems from the fact that human food conditioning and habituation are complicated behavioral concepts that are not fully understood (Whittaker and Knight 1998, Herrero et al. 2005, Smith et al. 2005). Herrero's (1985) popular description of a 'food-conditioned bear' has been cited differently in the literature, adding to the complication of understanding these management classifications. For example, Gunther (1994:551) interpreted Herrero's definition as ''bears that have learned to identify humans or human developments as a source of foods due to a prior food reward,'' while Smith et al. (2005:2) provided what we suggest is a more accurate definition: ''such a bear forms a simple association between people and food.'' In contrast to these definitions, Mattson et al. (1987:261) suggested food-conditioned bears are also habituated: ''habituated bears that characteristically associated feeding opportunities with human facilities.'' Although Herrero (1985:51) discussed the association between habituation and food conditioning, he suggested that food-conditioned bears are not always habituated: ''…the food-conditioned bear is almost always somewhat habituated to the smell or sight of people.''

Using the term habituation to describe a food-conditioned bear has resulted in the misquoted term 'food-habituated' (Smith et al. 2005). We suggest discontinuing this term's use because habituation and food conditioning are not always simultaneously acquired (Gilbert 1989, Fig. 2). In addition, the term 'food-habituated' is self-contradictory because bears that are habituated to people and are food-conditioned are, by definition, not habituated to human

food. Instead, they have a desire to seek human food and have become habituated to people in the process.

Bears that are food-conditioned (but not habituated) behave differently than bears that are habituated (but not food conditioned). Food-conditioned bears seek out anthropogenic stimuli (e.g., people, human scent, waste containers, human-use areas) and often obtain a human food reward in the process. This positive conditioning reinforces the attraction to the stimuli, thus perpetuating food-conditioned behavior. In contrast, habituated bears have a neutral response to anthropogenic stimuli and have a reduced ORD to people. Because human food conditioning and habituation are different processes in animal behavior, managers should evaluate them independently when classifying management bears and implementing management responses.

Our final distinction between a food-conditioned and a habituated bear is that a bear can be habituated but not food-conditioned (a food reward is not necessary for habituation), whereas food-conditioned bears often show signs of habituation (Fig. 2; Herrero 1985). Bears that are food-conditioned, habituated, or both habituated and food-conditioned are usually classified after direct observation. However, food-conditioned bears may also be identified via stable isotope methods (Hobson et al. 2000; Greenleaf 2005; Mizukami et al. 2005; JBH, unpublished data; RTS, unpublished data), trans fatty acids (Thieman et al. 2008), and body size (i.e., skeletal size and body weights normalized for season; RTS, unpublished data).

Habituated and food-conditioned bear. Many food-conditioned bears are habituated, and many habituated bears become food-conditioned. Therefore, there is a need for a management term that describes a bear that is both habituated and food-conditioned. Until another term is presented, we suggest classifying a bear that is habituated and receives anthropogenic food as habituated and food-conditioned (Fig. 2).

Aggressive and predatory bears. Bears may threaten people by exhibiting *aggressive behavior* (e.g., direct approaches to humans, bluff-charging, jaw or lip-popping, front leg stomping, loud vocalizations, circling, intense staring, salivating, non-predatory attack) during human–bear interactions. These behaviors may be stress-related and displayed defensively (e.g., protect young, ensure safety) in response to being *provoked*, or may be exhibited offensively (e.g., predatory attack, asserting dominance, taking food from people). In a management classification context, an *aggressive bear* displays aggressive behavior (defensive or offensive) and is a public safety concern. Under some circumstances it may be difficult to ascertain if a bear's aggressive behavior should be classified as a public safety concern. In situations such as these, it is important for management personnel to accurately document the bear's behavior (often on multiple occasions), and to analyze the context of the incidents. This information could aid managers in deciding whether the bear should be classified aggressive.

Although *offensive-aggressive* animals are often classified aggressive and subsequently removed from the population, *defensive-aggressive* bears may be removed as well. For instance, a female with cubs repeatedly bluff-charged trail users and eventually attacked a person in the outskirts of Anchorage in 2008. After the first incident it was clear the bear displayed aggressive behavior; however, it was unclear if the bear was acting offensively or defensively. In this case, the bear was not originally classified as an aggressive bear, but the repetition of similar defensive-aggressive incidents resulted in her being classified aggressive and lethally removed (R. Sinnott, Alaska Department of Fish and Game, Anchorage, Alaska, USA, personal communication, 2009). In contrast, a female black bear with cubs bluff-charged a person from 100 yards away in an open meadow and was never observed again that year. In this scenario, the bear was likely provoked and therefore responded with defensive-aggressive behavior to protect young and ensure safety. Given the bear's behavior and context of the incident, this bear should not be classified an aggressive bear (i.e., considered a public safety concern). We suggest classifying a bear aggressive if and only if the evidence is convincing (i.e., the behavior and incident are well documented, and typically repeated), because a bear classified aggressive is often removed from the population. *Predatory bears* are also typically removed from the population and are defined as bears that preyed or attempted to prey on people. Predatory bears were reported as displaying the following behaviors: ''searching, following or testing, attacking (capturing), killing, dragging a person, burying, and feeding upon a person'' (Herrero and Higgins 2003:46).

Unknown and unmanaged bears. The term 'wild bear' is commonly used to describe both a bear not contained in captivity (i.e., free-ranging) as well as a bear that flees during human–bear interactions. A bear considered neither habituated nor food-conditioned after monitoring is often referred to as 'wild', 'wary', or 'naïve'. However, a bear termed 'wild' in this way may have been classified habituated or another management status if observed under differing conditions (i.e., if influences on a bear's ORD were different). For example, a bear may have been originally classified 'wild' because it fled a remote area when approached unexpectedly, but may not have shown signs of avoidance if the interaction were less surprising or occurred along a road. In the latter situations it would have been classified as habituated. Thus, designating a bear 'wild' for management purposes is subjective; instead, we suggest classifying the bear as having an *unknown* management status. We also suggest classifying a bear as unknown when it has not been monitored, but will be in the future.

Many reviewers suggested we include a management classification for a bear that will not be monitored in the foreseeable future because it has not been observed interacting with people or suspected of being involved in any bear incidents. We suggest personnel refer to such bears as *unmanaged*. The term 'non-food-conditioned' typically implies the animal is habituated or unmanaged. To be confident the bear is not food-conditioned, the animal is monitored. If the manager is unsure whether the bear consumes human food, we suggest classifying the animal unknown and continue monitoring. If a monitored bear's management status is unclear, we suggest that it be classified unknown until empirical evidence suggests otherwise.

Bear sightings and incidents

A *bear sighting* has occurred when the bear (1) was seemingly unaware of the person observing it (i.e., not a human–bear interaction; Smith et al. 2005, Wilder et al. 2007), (2) had no observable stress-related response to the person during an interaction, or (3) responded to the person by taking *evasive action* (e.g., walked or ran away, climbed a tree; Fig. 3). The person involved in the latter type of sighting did not take extreme evasive action (e.g., ran away, climbed a tree, played dead, fired capsicum spray [bear deterrent spray], discharged ammunition from a firearm; Schirokauer and Boyd 1998) (Fig. 3). A *human–bear interaction* (or 'encounter,' Wilder et al. 2007) occurs when a person and bear are mutually aware of each other (Smith et al. 2005). During interactions with humans, bears either tolerate people (typically outside the bear's ORD), allowing people to observe them at a distance (documented as a bear sighting), or respond to humans inside their ORD with behavior that may or may not lead to human–bear conflict (Fig. 3). A *bear jam* is an instance when people slow or stop their vehicles to view or photograph bears, causing traffic congestion. We suggest documenting most bear jams as bear sightings. However, if a human–bear conflict transpired during the bear jam or the bear obtained anthropogenic food or caused property damage, we suggest recording the bear jam as a bear incident (Fig. 3).

A *human–bear conflict* has occurred when a bear has (1) exhibited stress-related or curious behavior, causing a person to take extreme evasive action (Schirokauer and Boyd 1998), (2) made physical contact with a person (e.g., to assert dominance, while acting defensively or taking human food) or exhibited clear predatory behavior, or (3) was intentionally harmed or killed (not including legal harvests) by a person (e.g., poached, wounded/killed in defense of life or property; Fig. 3). We agree that bears often respond to interactions with people by exhibiting aggressive behaviors to warn people to increase or maintain their distance. Although these behaviors are threatening, they are often a defense mechanism. Regardless of the reason bears exhibit these aggressive behaviors, we suggest documenting these human–bear interactions as human–bear conflicts if and only if the person took extreme evasive action (Schirokauer and Boyd 1998) (Fig. 3). We assume that if a bear caused a person to take extreme evasive action, the person must have felt threatened by the bear's behavior. Under this scenario, we believe the bear was involved in a conflict with the person. In addition to documenting evasive actions of bears and people during human–bear interactions, it is important to document the stress-related behavior bears exhibit during these interactions to better understand the dynamics of human–bear conflict.

A *bear incident* is an occurrence that involved (1) a human–bear conflict; or episodes where bears (2) caused property damage, (3) obtained anthropogenic food (includes being baited), (4) killed or attempted to kill livestock or pets, or (5) were involved in vehicle collisions (Fig. 3) (Gunther 1994, Schiro-

kauer and Boyd 1998, Gunther et al. 2004, Wilder et al. 2007). Currently, some human–bear management programs use variants of the term conflict (e.g., bear–human conflict, human–bear conflict, human conflict) instead of our term, bear incident. We suggest that managers make the distinction between episodes with and without direct conflict between people and bears. Specifically, we suggest recording all episodes involving bears and people (or their property) as bear incidents, while documenting any human–bear conflict (a subset of bear incidents) that transpired during the incident (Fig. 3, Table 2). For example, an incident occurred where a bear made physical contact with a person to acquire human food. In this case, we suggest recording the bear incident as a human–bear conflict where a bear also received human food. Another example: a bear broke a window of an unoccupied vehicle in a parking lot to obtain human food. We suggest recording this episode as a bear incident (but not as a human–bear conflict) where the bear obtained human food and caused property damage. Since it is often difficult to determine whether a human–bear interaction should be documented as a bear incident or a bear sighting, our flow chart (Fig. 3) and dichotomous key (Table 2) may aid in making a more objective decision.

Failing to remove anthropogenic food sources from bear habitat sometimes leads to undesirable human–bear interactions, resulting in conflict or other bear incidents. Regardless of whether the bear incident is human or bear-induced, the bear may be removed from the population (McCullough 1982). The term nuisance bear is commonly used to describe habituated bears or bears involved in human–bear conflict or other bear incidents. Generally speaking, managers consider nuisance bears to be pests. We believe referring to habituated bears as a nuisance does not accurately categorize these individuals. For example, a habituated bear that is commonly observed near the roadside foraging is typically not a nuisance to people. In fact, people enjoy observing them and these sightings often lead to opportunities to better educate visitors about bear behavior and food storage (KAG, unpublished data). In addition, a bear involved in incidents is not always a nuisance, especially if the bear was never involved in human–bear conflicts. We suggest using the general term *problem bear* to describe a bear involved in repeated incidents, regardless if they are a nuisance to people or not.

Management implications

Human–bear management strategies will continue to evolve as our knowledge of bear behavior and ecology increases. The most effective way to continue to improve methods to prevent bear incidents is for agencies to evaluate their programs using well defined terms and concepts, and communicate the successes and failures of their programs internally and externally. Bridging gaps in communication within and among agencies will ultimately improve site-specific, intra- and interagency bear conservation efforts, and bear research in the United States and Canada. In addition, effective communication may eventually lead to a clear definition for 'management success,' a term that is frequently used, but hardly ever defined, as well as a human–bear management database that can be used for meta-analysis.

We hope our suggestions will be used by wildlife management agencies with bear population management programs, as well as other wildlife professionals, to provide clarification of terms and concepts in human–bear management. We hope this document will foster discussion on establishing a common human–bear management language and provide direction to human–bear management programs and researchers.

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