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Original Article

Experience, Attitudes, and Demographic Factors Influence the Probability of Reporting Human–Black Bear Interactions

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ABSTRACT Interactions between people and American black bears (*Ursus americanus*) have been increasing throughout the United States, with negative interactions becoming a major management challenge for wildlife agencies. To monitor the number, location, and severity of these conflicts, wildlife agencies typically rely on voluntary public reports. Although trends in voluntary reports are commonly assumed to reflect actual trends in human–bear interactions, recent research suggests an individual's likelihood of reporting interactions may be biased, influenced by attitudes toward the species and its management, previous experiences with wildlife, or demographic factors. During 2012, we used a mail survey of residents in the vicinity of Durango, Colorado, USA, ($n = 1{,}667$) to explore the relative importance of tolerance for black bears, satisfaction with bear management, personal experience with bears, and demographic traits as predictors of a resident's decision to report interactions to the authorities. We found that residents' experiences with bears were most important in predicting reporting behavior, followed closely by attitudes related to tolerance for bears, and satisfaction with management; demographic factors had relatively little influence. Respondents were more likely to report when they had seen black bears near their homes, had been threatened by bears, were intolerant of bears, dissatisfied with management, and were female. Although several variables in our analyses were influential in explaining reporting behavior, the overall predictive power of our models was low ($R^2 = 0.17$), suggesting future investigations of reporting behavior should include a broader set of covariates. Our results indicate that public reports represent a biased measure of human–bear interactions, and management agencies should either account for bias, or collect different types of interaction data, when assessing patterns of bear activity. © 2018 The Wildlife Society.

KEY WORDS Colorado, human–wildlife conflict, mail survey, reporting behavior, *Ursus americanus*, wildlife management.

Negative interactions between humans and American black bears (*Ursus americanus*) have been increasing throughout the United States, becoming a major management challenge for wildlife agencies (Beckmann et al. 2004, Spencer et al. 2007, Baruch-Mordo et al. 2008). Along the urban–wildland interface, the primary cause of these interactions is the availability of anthropogenic food for bears (Spencer et al. 2007, Johnson et al. 2015, Lewis et al. 2015). Human-dominated landscapes contain a wealth of reliable, high-calorie foods, in the form of garbage, fruit trees, vegetable gardens, pet food, and bird feeders. As opportunistic foragers, black bears readily exploit these resources, resulting in increased interactions with people, and conflicts. For people, negative interactions can lead to increased public safety concerns, property damage, and high management costs (DeStefano and DeGraaf 2003, Spencer et al. 2007); whereas, for black bears, they can lead to increased mortality (Beckmann and Berger 2003). Given these consequences, many wildlife agencies have expanded management efforts to reduce negative human–black bear interactions using a diversity of strategies (Spencer et al. 2007).

The primary source of information used by wildlife agencies to track the frequency, location, and severity of interactions comes from voluntary reports of interactions by members of the public (Spencer et al. 2007). In addition to monitoring patterns over time, these reports are often used

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to direct local management actions and evaluate the effectiveness of newly implemented strategies designed to decrease negative interactions (Gore et al. 2006, Hristienko and McDonald 2007, Spencer et al. 2007). When wildlife agencies use public reports, they assume that these data accurately reflect patterns in human–bear interactions, but recent studies suggest this information may be biased. For example, Hayman et al. (2014) found that reporting of negative interactions with alligators (*Alligator mississippiensis*) was related to attitudes toward the species, location of the resident's home, and demographic factors. Further, Howe et al. (2010) found that reporting behavior for human–bear conflicts increased in response to a controversial management action, rather than in response to actual changes in bear activity. Although these studies highlight the potential bias in reporting data, little is known about the suite of factors that may influence reporting behavior, and such information continues to be widely employed by wildlife agencies.

Although numerous factors may contribute to the probability that a person reports negative interactions with wildlife, cognitive factors, such as attitudes about a species or its management, are likely critical. Attitude theory predicts that general and specific attitudes about wildlife and their management influence behavioral intentions, and, ultimately, behavior (Manfredo 2008). This was demonstrated in Hayman et al. (2014), who found that Floridians with more negative attitudes about nuisances caused by alligators, and who felt they were more at risk of these interactions, were more likely to request that a nuisance alligator be removed. A common metric used to assess attitudes about a wildlife species is 'tolerance,' measured as the desired change in the size of a wildlife population (Carpenter et al. 2000, Bruskotter et al. 2015). Using this approach, people that want a wildlife population to increase in size are considered 'tolerant,' while those that want to see a decrease in the population are considered 'intolerant.' Tolerance is an integrative measure that reflects the perceived risks and benefits of a species, as well as personal control over interactions with the species (Bruskotter and Wilson 2014). As a result, it is frequently used to monitor public attitudes about wildlife (Riley and Decker 2000, Lischka et al. 2008, Bruskotter et al. 2015) and changes in attitudes in response to management actions (Slagle et al. 2013). We may expect that individuals with low tolerance for bears may be more likely to report negative interactions, assuming this would encourage management agencies to take action. Conversely, individuals with high tolerance for bears may not be inclined to make a report because they may be concerned about potential negative consequences (e.g., translocation, lethal removal).

In addition to attitudes about the species, attitudes about management may affect reporting behavior. For example, in an assessment of crime reporting behavior, Goudriaan et al. (2004) found that positive beliefs about police competency had a positive effect on a victim's willingness to report a crime. Similarly, Rudolph and Riley (2014) found a positive relationship between hunter beliefs about the ability of state agencies to control wildlife disease and cooperation with efforts to harvest diseased animals. Given these studies, we may similarly expect that individuals who believe that the local management agency is effective at reducing conflicts may be more likely to report them than would those individuals who believe the agency is ineffective. Individuals may also be more willing to report interactions if they agree with the management strategies being employed (Rudolph and Riley 2014).

Personal experience with a particular wildlife species may also affect an individual's motivation to report interactions. For example, Kretser et al. (2009) found that individuals who had previously experienced negative interactions with bears (e.g., damage) were more likely to subsequently perceive more conflicts with bears. In another study, Gore et al. (2006) found that human behaviors that reduced the risk of negative interactions with bears (e.g., locking up garbage, removing bird feeders) became more common after residents had negative interactions with bears. Similarly, we expect that individuals who have experienced negative interactions with bears would be more likely to take action (in this case, reporting their interactions to the authorities) because they may perceive their report as a mechanism to reduce their future risk.

Demographic characteristics are a commonly explored driver of attitudes toward wildlife, although the effect of demographics is often variable (e.g., Vaske et al. 2001). For example, gender has been found to affect attitudes toward carnivores, with women expressing greater concern about negative interactions (Zinn and Pierce 2002); yet, in other cases, gender has had no such influence (e.g., Riley and Decker 2000). Hayman et al. (2014) found that the demographic trait of age was important, with older residents more likely to report negative interactions with alligators, but that other demographic characteristics (including gender) had no effect. Given that demographic traits are relatively easy to obtain, understanding their influence on reporting could be useful to management agencies, if they explain variation in the probability of making a report.

We contributed to this growing body of research by conducting a study to better understand the relative importance of different factors predicting the reporting of human–black bear interactions. Building on previous work assessing the accuracy of reporting data (Howe et al. 2010, Hayman et al. 2014), we explored a broad suite of cognitive factors, past experience with bears, and demographic traits to explain patterns of reporting. To conduct our investigation, we used responses from public mail surveys conducted in the vicinity of Durango, Colorado, USA, a city with large numbers of interactions between people and black bears (Baruch-Mordo et al. 2008), where public calls are used by management entities to assess annual patterns of bear activity. Specifically, our objectives were to 1) determine the relative influence of different types of variables (cognitive factors, experiences, and demographics) on self-reporting of negative human–bear interactions; and

2) develop a model for predicting reporting behavior using all variable types.

STUDY AREA

The city of Durango is located in southwestern Colorado (37.2753°N, 107.8801°W) and home to approximately 18,500 residents (U.S. Census Bureau 2017). Lands surrounding Durango were rich in natural amenities and popular for recreation, ranging between 1,930 and 3,600 m in elevation, and managed primarily by city, state, and federal agencies. The area was considered high-quality bear habitat, and dominated by ponderosa pine (*Pinus ponderosa*), Gambel oak (*Quercus gambelii*), aspen (*Populus tremuloides*), pinyon pine (*Pinus edulis*), juniper (*Juniperus* spp.), and mountain shrubs (e.g., *Prunus virginiana, Amelanchier alnifolia*).

Between 2010 and 2017, the human population of Durango grew at a rate of 10%, similar to the statewide rate of growth (11%; U.S. Census Bureau 2017), resulting in expanding residential development, particularly in exurban and rural areas. Like other mountain towns in Colorado, the population of Durango was highly mobile, with a relatively small percentage of individuals living in the same residence for >1 year (68%) and owning their own homes (49%; U.S. Census Bureau 2017). This may be a result of higher average home values (US$363,000 in Durango vs. US$247,000 in Colorado), lower median household incomes (US$57,000 in Durango vs. US$60,000 in Colorado), the student population attending Fort Lewis College, and high rates of seasonal employment associated with tourism (U.S. Census Bureau 2017). Given the juxtaposition of expanding residential development and black bear habitat, Durango experienced high rates of human–bear conflicts relative to other locations in the state (Baruch-Mordo et al. 2008).

METHODS

Mail Survey

To investigate factors associated with reporting negative interactions, we conducted a mail survey that was approved by Colorado State University Institutional Review Board (protocol ID #005-17H). We sent the survey to all residential parcels within the city limits of Durango ($n = 4{,}352$) and a random sample of residential parcels outside city limits, but within the county ($n = 1{,}500$ of 15,365). We used a modified version of the Tailored Design Method (Dillman et al. 2014) to administer the survey from January through April 2012. The survey consisted of 5 total mailings, sent at 2-week intervals: 3 copies of the survey, 1 reminder postcard, and 1 nonrespondent postcard. The survey measured respondents' tolerance for black bears, satisfaction with the management of human–black bear conflicts, experiences with black bears, and demographic traits. Four weeks after the final survey mailing, we sent a postage-paid, nonresponse postcard to the remaining nonrespondents. The postcard asked 5 questions, selected from the full survey, about demographic characteristics (age, gender, and homeowner status) and tolerance for bears. We used *t*-tests ($\alpha = 0.05$) to determine whether nonrespondents differed from respondents.

Factors Associated with Reporting Human–Black Bear Interactions

To determine factors associated with public reporting of human–black bear interactions, we first asked people taking the survey, "Did you report any negative interactions with bears you've experienced in the last 3 years to any authorities?" We used responses (yes or no) to this question as the binary dependent variable to examine the relative importance of cognitive factors, experience, and demo-

Table 1. Description of the survey questions and variables used to predict self-reporting behavior of human–black bear interactions in Durango, Colorado, USA, during 2012. Experiences that a resident had with a bear accessing food (FOOD) were summed across all 3 survey questions. Experiences related to human, pet, or livestock safety (SAFETY) were rare; therefore, they were transformed into binary response (1 = yes, 0 = no) and summed across the 3 survey questions. Reference (Ref) classes for categorical variables are defined.

Category	Variable	Survey question	Variable type
Cognitive factors	TOL	How would you like to see the number of black bears in the area where you live change in the next 3 years?	5 Categories (Ref = No Change)
	MGMT	Overall how would you rate management of black bear and human–bear interactions where you live?	5 Categories (Ref = Average)
Experience	SEEN	Saw black bears near my home	Continuous
	FOOD	Had a black bear break into or attempt to break into my garbage	Continuous
	FOOD	Had a black bear damage my garden or fruit trees	Continuous
	FOOD	Had a black bear damage my bird feeder, pet feeder, or grill	Continuous
	DAMAGE	Had a black bear cause damage to other property (e.g., fences, car, garage, etc.)	Continuous
	SAFETY	Had a black bear attack or harass my pets or livestock	Binary (yes or no)
	SAFETY	Had a black bear enter or attempt to enter my home	Binary (yes or no)
	SAFETY	Was attacked or harassed by a black bear myself	Binary (yes or no)
Demographic factors	AGE	Respondent's age: In what year were you born?	Continuous
	GENDER	Respondent's gender: Are you male or female?	2 Categories (Ref = Male)
	OWN	Respondent's home situation: Do you own or rent the home you live in?	2 Categories (Ref = Own)
	SETTING	Based on parcel location, respondents were classified as living in urban, exurban or rural neighborhoods.	3 Categories (Ref = Urban)

graphics in determining reporting. We focused on the last 3 years because this typically represents the period of time people can accurately recall events (Dillman et al. 2014).

In the survey, we measured attitudes related to tolerance for black bears and beliefs about the quality of management (see Table 1 for specific survey questions). Tolerance (TOL) was represented by the respondent's perception of the current black bear population compared with the desired change in the future bear population. We measured this on a 5-point scale that ranged from a resident's desire to see the population "decrease greatly" to "increase greatly" with a midpoint of "stay the same" (Table 1). We reclassified these responses into 5 categories from "greatly intolerant" to "greatly tolerant" with a reference category of "neither tolerant, nor intolerant." We also asked respondents to indicate their beliefs about the quality of management of human–bear interactions (MGMT). We coded responses as a categorical variable, measured on a 5-point scale that ranged from "poor" to "excellent," with "average" as the reference category (Table 1).

To understand the role of individual experience with black bears on rates of reporting, we asked respondents about their interactions with bears. Specifically, we asked whether residents had seen black bears near their home (SEEN; 1 question), had bears accessed food resources on their properties (FOOD; 3 questions: had a bear accessed trash, bird feeder, and garden), had bears caused damage to their property (DAMAGE; 1 question), and had bears threatened their safety (SAFETY; 3 questions: had a bear entered your home, attacked or harassed a pet or livestock, or attacked or harassed the respondent). Respondents indicated the frequency of each of these interactions as 0 times, 1–2 times, 3–4 times, and $\geq$5 times. We summed the lowest value of each category (i.e., "1–2 times" = 1 interaction) to create an index of the relative frequency of each type of interaction for each respondent. For questions related to SEEN, FOOD, and DAMAGE we added the number of experiences within each category and treated these values as continuous variables in our analyses. The number of interactions related to SAFETY were small (<2% of respondents had this interaction); therefore, we coded these events as binary (yes or no; Table 1).

To investigate demographic factors associated with reporting, we asked survey respondents to indicate their age (AGE), gender (GENDER), and whether they owned or rented the house in which they were living (OWN; Table 1). We also investigated whether the setting of a respondent's home was associated with rates of reporting (SETTING) by categorizing respondents as living in urban (>5.0 housing units/ha), suburban (0.6–5.0 units/ha), or rural areas (<0.6 units/ha; Bierwagen et al. 2010) based on parcel data from La Plata County.

Data Analysis

To address our first objective of assessing the relative importance of different types of variables on influencing the self-reporting of negative human–bear interactions, we used logistic regression. We grouped predictor variables into 3 categories, based on whether they were associated with cognitive factors, experiences, or demographic characteristics (Table 1). We then used an all-subsets modeling approach to compare the fit of different models representing these categories to predict reporting behavior. Before initiating modeling, we assessed multicollinearity among continuous predictor variables using correlation coefficients ($r > |0.6|$; Cohen 1988) and among categorical predictor variables using chi-square statistics ($P \leq 0.05$); results revealed no collinearity among variables. We used Akaike's Information Criteria (AIC) and model weights to assess model support (Burnham and Anderson 2002). Additionally, for the top-ranked model in each category, we estimated the proportion of explained variation using Nagelkerke R^2 value (Nagelkerke 1991).

To address our second objective, developing the best predictive model of variables associated with reporting behavior, we conducted all-subsets model selection from all possible variable combinations across categories. Again, we tested for multicollinearity, but found that no variables were highly correlated. We calculated AIC values and model weights, and averaged models (Lukacs et al. 2010) with AIC weights >0.01 to obtain final coefficient estimates. We also ranked the importance of different variables by summing AIC weights for all models containing that variable, and calculated Nagelkerke R^2 value for our top-ranked predictive model.

RESULTS

Of the 5,258 surveys delivered (523 surveys were undeliverable), we received 2,947 (56%) valid responses (2,170 from within city limits and 777 from the county) for a corrected response rate of 55%. We excluded surveys from residents that failed to provide valid responses for all predictor variables (derived from 13 different survey questions), which reduced our sample size to 1,667 surveys. This large reduction in sample size resulted from numerous "not sure," "no opinion," or blank responses to different survey questions. These invalid responses were spread across the survey questions with 16% unusable responses for TOL, 14% for MGMT, 4–6% for food and safety related questions (3 questions each), 4% for SEEN and DAMAGE, 3% for GENDER and AGE, and 2% for OWN. Invalid responses were smallest for demographic questions (i.e., AGE, GENDER, and OWN) that could only have blank answers (2–3%), greater for SEEN, FOOD, DAMAGE, and SAFETY questions that had blank and "not sure" answers (4–6%), and greatest for TOL and MGMT questions which had blank, "not sure," and "no opinion" answers (14–16%). Of the 1,667 surveys with valid responses for all predictor variables, an additional 3.6% ($n = 60$) were removed from our analyses because residents had not had any interactions with black bears in the past 3 years. We received 354 responses (16% response rate) to the nonresponse postcard, which is similar to rates reported from postcards in other wildlife surveys (Marcoux and Riley 2010, Lesser et al. 2011; S. Lischka, Colorado Parks and Wildlife, unpublished data). Survey respondents did not differ from nonrespondents in preferences for the future size of the bear population

Table 2. Model selection results from assessing variables associated with reporting human–black bear interactions based on survey data collected in Durango, Colorado, USA, during 2012. The probability of reporting negative interactions was assessed separately for variables related to cognitive factors, experience with bears, and demographic characteristics. Within each category, variables were tested using an all-subsets approach. We provide results for those models having an Akaike's Information Criterion (AIC) score <4 from the top-ranked model (null model AIC = 1,291.30) within each category. All models included an intercept term.

Category	Models[a]	K[b]	AIC	ΔAIC[c]	w_i[d]
Cognitive	TOL + MGMT	9	1,217.28	0.00	1.00
Experience	SEEN + FOOD + DAMAGE + SAFETY	5	1,192.39	0.00	0.44
	SEEN + DAMAGE + SAFETY	4	1,192.48	0.08	0.42
	SEEN + FOOD + SAFETY	4	1,195.38	2.98	0.10
Demographic	GENDER	2	1,289.00	0.00	0.21
	GENDER + AGE	3	1,290.29	1.29	0.11
	GENDER + OWN	3	1,290.69	1.69	0.09
	GENDER + SETTING	4	1,291.01	2.01	0.08
	GENDER + AGE + OWN	4	1,291.43	2.42	0.06
	GENDER + AGE + SETTING	5	1,292.41	3.41	0.04
	GENDER + OWN + SETTING	5	1,292.60	3.59	0.04
	AGE	2	1,292.76	3.75	0.03

[a] Variables defined in Table 1.
[b] K is the number of estimated model parameters.
[c] ΔAIC is the difference in AIC units from the top-ranked model.
[d] w_i is the AIC model weight.

($\bar{x}_{\text{respondents}} = 3.22$, $\text{SE}_{\text{respondents}} = 0.02$, $\bar{x}_{\text{nonrespondents}} = 3.31$, $\text{SE}_{\text{nonrespondents}} = 0.06$, $t_{2752} = -1.47$, $P = 0.14$) or concern about negative interactions with black bears ($\bar{x}_{\text{respondents}} = 2.28$, $\text{SE}_{\text{respondents}} = 0.02$, $\bar{x}_{\text{nonrespondents}} = 2.91$, $\text{SE}_{\text{nonrespondents}} = 0.08$, $t_{3020} = 1.36$, $P = 0.17$).

From the final pool of surveys, 68% of respondents had experienced ≥1 negative interaction with bears in the past 3 years, yet only 13% of respondents had reported interactions to the authorities. Most respondents were neither tolerant, nor intolerant of black bears (58%), while 11% were greatly intolerant, 17% were slightly intolerant, 11% were slightly tolerant and 3% were highly tolerant. With respect to satisfaction with the management of human–bear interactions, 6% scored management as poor, 7% as below average, 35% as average, 41% as above average, and 11% as excellent. The most frequent interaction that people had with black bears was seeing them near home (48% ≥1 time) and having bears access a food resource on their property (41% ≥1 time). The most infrequent interactions were experiencing property damage (8% ≥1 time) and threatening

Table 3. Model selection results from identifying the best predictive model of reporting human–black bear interactions in Durango, Colorado, USA, during 2012. Variables representing cognitive factors (TOL and MGMT), experience (SEEN, FOOD, DAMAGE, and SAFETY), and demographic characteristics (AGE, GENDER, OWN, and SETTING) were included. We provide results for those models having an Akaike's Information Criterion (AIC) score <4 from the top-ranked model (null model AIC = 1,291.30).

Model[a]	K[b]	AIC	ΔAIC[c]	w_i[d]
TOL + MGMT + SEEN + DAMAGE + SAFETY + GENDER	13	1,153.86	0.00	0.10
TOL + MGMT + SEEN + DAMAGE + SAFETY + GENDER + OWN	14	1,153.92	0.06	0.10
TOL + MGMT + SEEN + FOOD + DAMAGE + SAFETY + GENDER	14	1,155.16	1.30	0.05
TOL + MGMT + SEEN + FOOD + DAMAGE + SAFETY + GENDER + OWN	15	1,155.27	1.41	0.05
TOL + MGMT + SEEN + FOOD + SAFETY + GENDER	13	1,155.77	1.92	0.04
TOL + MGMT + SEEN + DAMAGE + SAFETY + GENDER + AGE + OWN	15	1,155.80	1.95	0.04
TOL + MGMT + SEEN + FOOD + SAFETY + GENDER + OWN	14	1,155.84	1.98	0.04
TOL + MGMT + SEEN + DAMAGE + SAFETY + GENDER + AGE	14	1,155.88	2.02	0.04
TOL + MGMT + SEEN + SAFETY + GENDER + OWN	13	1,156.17	2.31	0.03
TOL + MGMT + SEEN + SAFETY + GENDER	12	1,156.25	2.39	0.03
TOL + MGMT + SEEN + DAMAGE + SAFETY + GENDER + SETTING	15	1,156.61	2.75	0.02
TOL + MGMT + SEEN + DAMAGE + SAFETY + GENDER + OWN + SETTING	16	1,156.77	2.91	0.02
TOL + MGMT + SEEN + FOOD + DAMAGE + SAFETY + GENDER + AGE + OWN	16	1,157.14	3.28	0.02
TOL + MGMT + SEEN + FOOD + DAMAGE + SAFETY + GENDER + AGE	15	1,157.19	3.33	0.02
TOL + MGMT + SEEN + FOOD + SAFETY + GENDER + AGE + OWN	15	1,157.59	3.73	0.02
TOL + MGMT + FOOD + DAMAGE + SAFETY + GENDER	13	1,157.62	3.76	0.01
TOL + MGMT + SEEN + FOOD + DAMAGE + SAFETY + GENDER + SETTING	16	1,157.77	3.91	0.01
TOL + MGMT + SEEN + FOOD + SAFETY + GENDER + AGE	14	1,157.81	3.95	0.01
TOL + MGMT + SEEN + DAMAGE + SAFETY + OWN	13	1,157.81	3.96	0.01
TOL + MGMT + SEEN + DAMAGE + SAFETY	12	1,157.84	3.98	0.01

[a] Variables defined in Table 1.
[b] K is the number of estimated model parameters.
[c] ΔAIC is the difference in AIC units from the top-ranked model.
[d] w_i is the AIC model weight.

behaviors by bears (2% ≥1 time). The average age of a respondent was 55 years (SE = 0.35, range = 14–95), and 55% were male while 45% were female. Most of the respondents owned their home (86%), with a majority living in urban neighborhoods (62%), followed by suburban (31%) and rural (7%) neighborhoods.

When evaluating which variable type (cognitive factors, experiences, or demographics) was most important in predicting reporting behavior, we found that experiences with bears had the strongest support based on AIC values (Table 2). The top-ranked model included all 4 types of interactions (SEEN, FOOD, DAMAGE, and SAFETY), although the inclusion of FOOD added little additional explanatory power (the second-ranked model without FOOD had ΔAIC = 0.08). Generally, as the number of experiences with bears increased, people were more likely to report them, particularly for conflicts related to SAFETY (Supporting Information, Table S1). After experience, variables reflecting cognitive factors (attitudes related to tolerance of bears and beliefs about the quality of management) had the most support (Table 2). Respondents who were greatly intolerant of black bears and felt that management was poor were most likely to report negative interactions (Supporting Information, Table S1). Models based on demographic factors exhibited the least support. The top-ranked demographic model included only gender (with females more likely to report); however, age, home-ownership, and neighborhood also appeared in models with ΔAIC <2 (Table 2). The top-ranked models representing experience, cognitive factors, or demographic variables had Nagelkerke R^2 values of 0.12, 0.10, and 0.01, respectively.

When evaluating all variables simultaneously to develop the best predictive model of reporting behavior, we found that a combination of experience, cognitive factors, and demographic variables were important (Table 3, Figs. 1 and 2). Eight models were within 2 AIC units of the top-ranked model and included the following variables: SEEN, DAMAGE, SAFETY, TOL, MGMT, GENDER, OWN, and AGE. The probability of reporting significantly increased for people that were intolerant of bears and believed management was poor. For example, the odds of reporting an interaction was 2.5 times greater for people that were greatly intolerant of bears compared with those that were neither tolerant nor intolerant, and 2.8 times greater for residents that considered management to be poor compared with residents that considered management to be average. Reporting also increased for residents having frequent interactions with bears (bears threatening their safety, seeing bears near their home, and having property damage by bears), and residents that experienced SAFETY interactions were 2.7 times more likely to report interactions than those that did not. Reporting also increased for females and renters—these factors increased the odds of reporting by 1.5 and 1.4, respectively (Table 4; Fig. 2). Although age was included in one of these top-ranked models, the standard error of the coefficient signaled that it was not important in predicting reporting behavior (Table 4). Model selection metrics indicated that the most important variables were experiences related to human or pet safety, beliefs about management, and tolerance of bears (Fig. 1). The Nagelkerke R^2 of our best predictive model was 0.17.

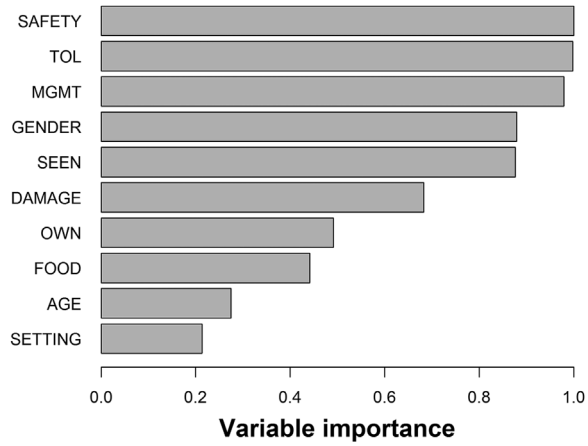

Figure 1. Variable importance values from all-subsets model selection, assessing the relative influence of cognitive factors (tolerance for bears [TOL] and satisfaction in management [MGMT]), experiences (saw a bear near home [SEEN], had a bear acquire anthropogenic food on property [FOOD], had property damage by a bear [DAMAGE], or had a bear threaten pet, livestock or human safety [SAFETY]), and demographic variables (based on a resident's AGE, GENDER, homeownership [OWN], and whether they lived in an urban, exurban or rural area [SETTING]) for predicting human–black bear conflict reporting in Durango, Colorado, USA, during 2012.

DISCUSSION

Wildlife management agencies obtain most of their data about human–wildlife conflicts from voluntary public reports, yet little is known about factors that influence people to provide this information. In comparing the relative influence of cognitive factors, experiences, and demographics on affecting reporting behavior, we found that the probability of reporting was most strongly related to resident experiences with bears. We found that more severe experiences (i.e., related to SAFETY and DAMAGE) had the greatest effect on reporting behavior, similar to the findings of Kretser et al. (2009). We were surprised that the experience of just seeing a bear had such a strong influence on reporting behavior, given that this is a relatively common occurrence (48% of respondents saw a bear near their home ≥1 time). We had expected that frequent, benign interactions would habituate residents to bears (Slovic 1987), reducing risk perceptions and demotivating reporting behavior (Siemer et al. 2009); however, we found that regular interactions with bears seem to sensitize residents (Naughton-Treves and Treves 2005) and motivate reporting behavior. Our results contradict Siemer et al. (2009), who found that benign interactions with black bears reduced resident predispositions to contact the authorities. Their study, however, assessed survey responses of behavioral intentions to make a report, rather than asking residents directly about their past behaviors. This key difference between our studies may explain our inconsistent findings, even when evaluating outcomes from the same type of

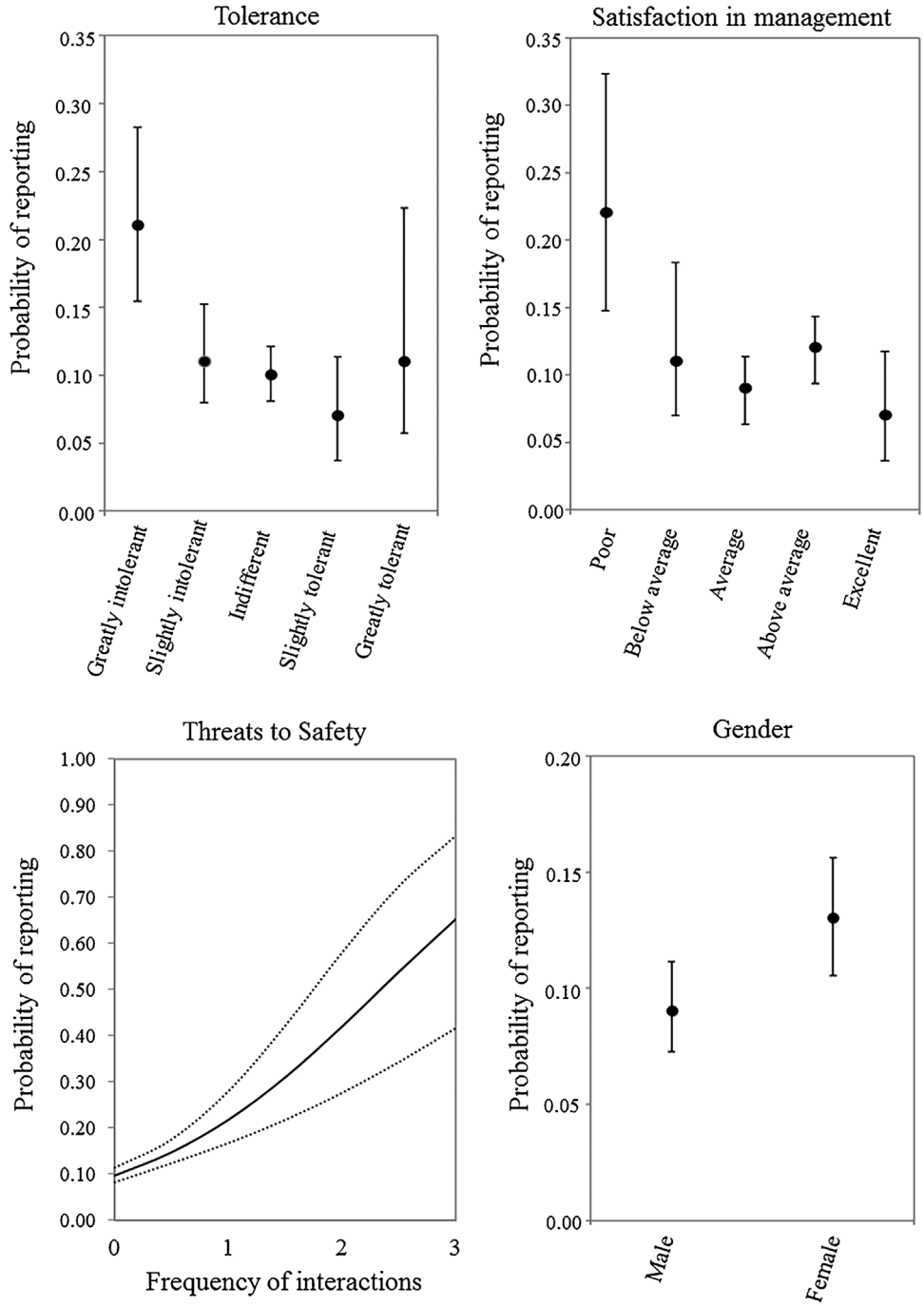

Figure 2. Modeled predicted effects (with 95% CIs) of tolerance, satisfaction with wildlife management, experiencing threatening behavior by bears, and gender on the probability of reporting a human–black bear interaction around Durango, Colorado, USA, during 2012. Predictions are based on model-averaged parameter values. We display the covariate of interest across its observed range of values and hold all other covariates at their reference class or mean. The reference class for tolerance was "neither tolerant nor intolerant," for satisfaction with management was "average," and for gender was "male."

human–wildlife interaction (i.e., human–bear interaction). Indeed, this difference highlights the need to examine the role of experience on human behavior, not just behavioral intentions, to better understand how interactions may habituate or sensitize residents to wildlife (McCleery et al. 2006).

Reduced tolerance for black bears was also associated with greater rates of reporting, corroborating findings of Kretser et al. (2009) and Hayman et al. (2014) who observed increased reporting of human–wildlife conflicts from residents with more negative attitudes toward the species. Although tolerance reflects both the perceived benefits and risks associated with a species (Bruskotter and Wilson 2014), perceived risks are often high for large carnivores and more influential on shaping resident attitudes than perceived benefits (Johansson and Karlsson 2011, Zajac et al. 2012). In a study of attitudes about human–bear interactions, Zajac et al. (2012) found that people perceived greater risks when

Table 4. Model-averaged coefficients associated with the probability of reporting human–bear interactions in Durango, Colorado, USA, during 2012, based on cognitive factors (TOL and MGMT), experiences (SEEN, FOOD, DAMAGE, and SAFETY), and demographic variables (AGE, GENDER, OWN, and SETTING). Reference (Ref) classes for categorical variables are defined.

Variable[a]	β	SE	Lower 95% CL	Upper 95% CL	*P*
Intercept	−2.92	0.30	−3.50	−2.34	<0.01
SAFETY	0.99	0.17	0.65	1.32	<0.01
MGMT (Ref = Average)					
Poor	1.03	0.29	0.46	1.59	<0.01
Below average	0.22	0.31	−0.38	0.82	0.46
Above average	0.23	0.19	−0.13	0.59	0.19
Excellent	−0.38	0.35	−1.06	0.30	0.28
TOL (Ref = Neither intolerant nor tolerant)					
Greatly intolerant	0.91	0.23	0.47	1.36	<0.01
Slightly intolerant	0.14	0.22	−0.28	0.56	0.56
Slightly tolerant	−0.45	0.33	−1.09	0.18	0.17
Greatly tolerant	0.10	0.46	−0.08	0.99	0.86
GENDER (Ref = Male)	0.39	0.16	0.65	0.71	0.01
SEEN	0.12	0.05	0.02	0.21	0.03
DAMAGE	0.15	0.08	0.00	0.31	0.14
OWN (Ref = Own)	0.33	0.23	−0.12	0.78	0.15
FOOD	0.04	0.03	−0.02	0.10	0.35
AGE	0.00	0.01	−0.01	0.01	0.69
SETTING (Ref = Urban)					
Suburban	−0.12	0.18	−0.48	0.23	0.58
Rural	0.24	0.30	−0.34	0.82	0.38

[a] Variables defined in Table 1.

they felt they had little personal control over their interactions with bears. Although we did not measure risk perceptions in our study, we suspect that the link between perceived risk and perceived control is critical in driving reporting behavior because people with relatively high perceptions of risk may use reporting as a strategy to take action. Although the antecedents of tolerance for wildlife have been widely studied (see review by Bruskotter and Wilson 2014), the link between tolerance and behavior is less well-understood. This will be an important avenue for future research as wildlife management agencies attempt to change human behavior to reduce human–wildlife conflicts.

Similarly, our results indicate that resident dissatisfaction with the management of bears and human–bear interactions predicted reporting behaviors. Although little is known about the role of attitudes about management in influencing human–wildlife reporting behavior, Howe et al. (2010) found that reports of black bears increased after a controversial management decision to cancel a spring bear hunt. The authors concluded that increased reports were not associated with increased bear activity, but instead with heightened dissatisfaction with management of negative interactions. In both our study and Howe et al. (2010), the people most displeased with management were those that called the managing agencies with information. This pattern differs from Rudolph and Riley (2014), where people were more likely to cooperate with the authorities if they perceived them to be competent, and suggests that the relationship between reporting behavior and satisfaction with management may be largely context-dependent. In our study and Howe et al. (2010), residents made reports to Colorado Parks and Wildlife in an attempt to trigger a management response, whereas in Rudolph and Riley (2014) residents were solicited to cooperate with existing management actions. These differences suggest that unsolicited public reports may be largely biased toward residents that are dissatisfied with current management practices, whereas solicited reports may be biased toward residents that are content with management. Understanding differences between these audiences could help wildlife agencies target their outreach and messaging in the future.

Although reporting behavior was strongly associated with resident attitudes and experiences, it was weakly associated with demographic traits. Only gender was statistically significant, with the odds of a female reporting a conflict being 1.5 times greater than a male. Interestingly, our results contradict Siemer et al. (2009) and Hayman et al. (2014), who found no relationship between gender and the likelihood of reporting a human–wildlife interaction to the authorities. Rather than reflecting actual differences in motivations, gender may in fact reflect latent influences on behavior, such as differences in the perceived effect of negative interactions with wildlife. For example, Gore and Kahler (2012) found that women were more concerned about the outcomes of negative interactions on people, and men reported greater concern for the outcomes for wildlife; whereas, Zinn and Pierce (2002) reported women were more concerned about predator attacks than men. In our study system, we expect that similar causal pathways may be in effect, where women were more likely to report interactions given heightened concerns about public safety.

Despite the relationships we found between specific predictor variables and the probability of reporting, our best model still had limited predictive power, suggesting that factors outside the scope of our study are important in

understanding reporting behaviors. Hayman et al. (2014) found that individuals who believed risks from alligators were high were more likely to report interactions to the authorities. In our study, we did not explore the explicit role of risk perceptions on reporting behaviors, although they are likely to be influential. Other attitudes are also known to influence tolerance for wildlife, such as perceptions of personal control, benefits associated with the species, and social trust in management agencies. Including these attitudes in future analyses may increase our understanding of self-reporting behavior (Zajac et al. 2012). Although our work highlights some key factors associated with the probability of reporting negative interactions, future research should evaluate a broader array of factors that may increase the predictive power of reporting models (Kretser et al. 2009), and test how these relationships hold for different types of human–wildlife interactions and in different locations.

MANAGEMENT IMPLICATIONS

Wildlife agencies commonly rely on self-reporting data to assess trends in human–bear interactions, but our results indicate that these public reports may mischaracterize the frequency of such interactions. For example, when attitudes about public tolerance for bears or support for management agencies are geographically clustered, that spatial variation may also be evident in reports of human–bear interactions, irrespective of patterns of actual incidents. Such patterns could bias the evaluation of management interventions. For example, if agencies take action to reduce negative human–bear interactions (e.g., distributing bear-proof containers), residents who are intolerant of bears and dissatisfied with management may continue to report 'negative' interactions such as seeing bears near their homes; whereas, respondents who believe the new management action is effective may not report their interactions, even if they increase. As a result, managers should consider collecting additional data types, unrelated to public self-reports, to accurately track spatio-temporal patterns in human–bear interactions. Although bias in self-reporting data limits the utility of this data type for monitoring spatio-temporal trends in interactions, agencies could use information about the characteristics of those people that report to guide future communication strategies. For example, people that report negative human–bear interactions may be an ideal audience to target for messaging and outreach about bears, bear management, and human–wildlife coexistence (Slagle et al. 2013).

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article at the publisher's web-site.

Table S1. Model-averaged coefficients associated with probabilities of reporting human–bear interactions in Durango, Colorado, USA, during 2012, based on only cognitive factors, experiences, or demographic variables, respectively (separate models for each type of factor).

Summary for Online TOC: We used a mail survey to determine the relative importance of tolerance for black bears, satisfaction with the management of bears, past experience with bears, and demographic traits in predicting the probability that a citizen would report a human–bear interaction to the authorities. Residents' experiences with bears were most important in predicting reporting behavior, followed by tolerance for bears, and satisfaction with management; respondents were more likely to report when they had seen bears near their homes, had been threatened by bears, were intolerant of bears, and dissatisfied with management.