Behavioral and attitudinal change of residents exposed to human–bear interactions

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Abstract: Human–black bear (*Ursus americanus*) interactions (HBI) have been increasing in frequency and magnitude in North America since the 1960s, and many wildlife management agencies are turning to proactive management actions to reverse this trend. Information and education efforts (IEE) are the most common proactive management actions used; however, few studies monitor behavior and attitudes of residents exposed to HBI and IEE. We used a case study in the Rattlesnake Valley of Missoula, Montana, USA to describe the diversity of anthropogenic attractants available to black bears based on self-reported human behaviors, and to test for changes in resident behavior and attitudes over a 4-year exposure to HBI and IEE. We identified >5 non-vegetative attractants, and >12 species of native and non-native vegetation available to black bears. Comparing the responses from mail questionnaires in 2004 (n = 369, response rate = 74%) and 2008 (n = 560, response rate = 60.1%), we found that the prevalence of 1 important behavior (outdoor garbage storage) decreased, and support for management actions used to deal with HBI increased, suggesting behavior and attitudes of residents changed from 2004 to 2008. We suggest that bear managers developing proactive management plans for HBI must incorporate (1) the varying effects of reducing the prevalence of 1 or numerous attractants, (2) the changing dynamics of human behavior and attitudes, and (3) the importance of incorporating monitoring and evaluation procedures.

Key words: black bear, education, human attitudes, human behavior, human–wildlife interactions

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As the number of humans continues to increase globally, interactions with bears (*Ursus* spp.) will persist as an important conservation and management issue. Human–black bear (*U. americanus*) interactions (HBI) have been increasing in frequency and magnitude in North America since the 1960s (Conover and Decker 1991, Beckmann and Berger 2003). HBI can be defined minimally as an occurrence when both a human and a bear are aware of each other's presence, but can also include human–bear conflicts where a bear makes physical contact with a person or displays a stress-related behavior (Hopkins et al. 2010). Wildlife management agencies are interested in reducing the number of HBI because of limited resources and the mandate to manage wildlife populations. Unfortunately, interactions are often of interest to numerous stakeholder groups, subjected to intense political scrutiny, and are associated with limited biological data, creating complex decision-making situations for bear managers.

Most management of HBI relies on reactive management, where managers respond immediately and directly to individual bears involved in interactions (Hopkins et al. 2010). However, implementing reactive management actions can be time consuming (Garshelis 1989), so many wildlife management agencies are turning to proactive management actions (Spencer et al. 2007), where preventative management is implemented to deter bears from getting involved in future HBI (Hopkins et al. 2010). The main proactive management action used by agencies is information and education efforts (IEE) directed toward the public, where a variety of organizations (e.g., community associations, government agencies; Gore et al. 2006) collaborate to promote responsible behavior (Disinger 1983), increase knowledge regarding bear biology and management, and change attitudes

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regarding management of human–bear interactions (Zint et al. 2002).

Essential to successful wildlife management, and especially proactive management involving black bears, is a thorough understanding of human dimensions (Decker and Enck 1996). Monitoring human attitudes and behavior will aid in the understanding of diverse stakeholder groups (Decker and Enck 1996) and provide information for IEE development and reorganization (Gore et al. 2006). For example, managers may alter curriculum for their IEE when the recipients of the curriculum change their attitudes (e.g., increase their support) regarding a certain management action (e.g., lethal control). To our knowledge, few studies monitor human behavior and attitudes in areas where HBI occur to provide information for proactive human–black bear management (Gore et al. 2008).

We used a case study in Missoula, Montana, USA, where an increase in HBI and a subsequent increase in IEE created a scenario where potential changes in self-reported human behaviors and attitudes could be monitored. Significant increases in HBI in the mid to late 1990s instigated a movement to develop IEE in the Rattlesnake Valley neighborhood of Missoula. Led by the Missoula Bear Task Force (a community-based bear awareness program) and Montana Fish, Wildlife & Parks (MFWP), IEE were developed and implemented by 2004. The goal of this IEE was to decrease the prevalence of human-created bear attractants (i.e., anthropogenic foods, garbage, pet food, chicken coops, compost piles, bird seed, barbecue grills [BBQ], orchards, gardens), and to increase human awareness of bears, bear biology, and management. Information pamphlets, newsletters, door hangers, signs, kiosks, posters, annual bear fairs, and a website, along with door-to-door contacts and presentations at local interest group meetings were all used to disseminate information to the public (J.J. Jonkel, MFWP, Missoula, Montana, USA, personal communication, 2010). We monitored human behavior and attitudes by comparing public surveys implemented in the initial stages of IEE and 4 years later.

Our objectives were to describe the diversity of anthropogenic attractants available to black bears within the Rattlesnake Valley of Missoula based on self-reported behavior and test for changes in resident behavior and attitudes in an area where residents were exposed to HBI and IEE. We defined trends in human behavior and attitudes as positive when residents reported (1) a decrease in frequency of $\geq$1 behavior that provided bear attractants or (2) an increase in support for any bear management action. We expected resident knowledge of bear biology, conflicts, and management would be enhanced, resulting in more responsible behavior and higher support for management actions used to deal with HBI.

Study area

At the time of our research, Missoula, Montana was inhabited by approximately 65,000 people, spanning 62 km^2 (US Census Bureau 2000). Average human density was approximately 1,046 people/km^2, and average housing density was 407.5 housing units/km^2. Gender ratio of residents was approximately 1:1, and the median age was 30.3 years (US Census Bureau 2000). The city lies in a valley bottom at 978 m in elevation, where the Clark Fork and Bitterroot rivers converge. The Bitterroot Mountains abut the city to the west, and the Garnet Mountains to the east. The surrounding land owners were private ranchers and the US Forest Service. The mountains that surround Missoula rise to 2,766 m. Most urban development lies in the flat valley bottom, whereas the surrounding mountains are characterized by steep slopes and canyons of coniferous forest.

MFWP records public phone calls about bears, unrelated to harvest, in a database containing information on type of HBI (e.g., sighting or human–bear incident), date, and location. Most HBI occur in the wildland–urban interface (WUI) of Missoula; few occur in the city core. The majority of HBI reported in the WUI are from the Rattlesnake Valley, a northern protrusion of the city with >2,000 residents; it is 8 km long, 0.5–1.5 km wide. Before 1950, the valley attracted bears with orchards, a mink (*Neovision vison*) and fox (*Vulpes vulpes*) farm, and a slaughterhouse (Booth 2005). Prior to 1997, approximately 15 reactive bear management actions were carried out annually in response to human–bear incidents (i.e., occurrences where bears caused property damage, obtained anthropogenic food, killed livestock or pets, or were involved in a human–bear conflict; Hopkins et al. 2010) in Missoula. The number of reactive bear management actions increased since 1997 and by 2004, Missoula residents reported 275 HBI and incidents, and MFWP addressed >50 of those incidents with reactive bear management actions. Since

2004, residents reported approximately 130 HBI and incidents annually, and MFWP responded to >30 of those incidents with reactive bear management actions.

Methods

Sampling and implementation

We distributed mail surveys in 2004 and 2008 to Rattlesnake Valley residents with comparable questions regarding human–black bear incidents, sightings, attractants, and management. In the 2004 survey, we selected 500 residences in the Rattlesnake Valley to receive the questionnaire. We randomly selected these residents after numbering each property using a Missoula county zoning map. Surveys and a self-addressed and stamped return envelope were delivered in person and left with a household member >18 years of age. Two in-person delivery attempts were made; if no one answered the door on the second attempt, the survey was left with a handwritten note requesting participation. A postcard reminder was mailed to each non-respondent within 2 weeks after delivery (Booth 2005). We received 369 returned surveys for a 74% response rate.

In the 2008 survey, we randomly selected 1,000 residents in the Rattlesnake Valley using a sampling firm (Survey Sampling, Inc., Fairfield, Connecticut, USA). They accessed samples from a computer database of telephone and address listings categorized by census neighborhood block groups. Neighborhood block groups are the smallest geographical unit in which census data are published (US Census Bureau 2000). We modified Dillman's (2007) 5-part mail process and sent 3 mailings: an introduction letter, the survey and a self-addressed return envelope 1 week later; and a reminder postcard 4 weeks after the survey was sent. We received 560 completed surveys and 68 incomplete surveys because of failed addresses, for a 60.1% response rate. Non-response was assessed by attempting to contact 10% of non-respondents by phone and asking 7 representative questions from the survey. We successfully contacted 32 non-respondents.

The questionnaire

All questions used in this study were presented in a multiple-choice format. Both the 2004 and 2008 surveys contained identical questions regarding resident demographics, behavior that produce bear attractants, and attitudes toward a variety of management actions. However, the 2008 survey included additional questions regarding the diversity of attractants, because after implementing the 2004 survey, it was clear that we did not survey all potential attractants. We tracked demographic variables to test for sampling bias between sampling periods including gender, age (18–25, 26–35, 36–45, 46–55, 56–65, >65), and highest level of education achieved (some high school, high school, some college, bachelor's degree, graduate degree).

To test for changes in self-reported behavior, respondents in both surveys were asked a variety of questions regarding their direct or indirect contribution of human-created bear attractants, including the presence of bird feeders, outdoor BBQ grills, outdoor compost piles, and the location of pet food and garbage container storage. Additionally, questions regarding the presence of outdoor chicken coops, gardens, berry bushes (i.e., raspberry, holy, blueberry, strawberry, grape, serviceberry [*Amelanchier alnifolia*], elderberry [*Sambucus* spp.], mountain ash [*Sorbus* spp.]), and fruit-bearing trees (apple, pear, cherry, peach, other) were included only in the 2008 survey and were used to assess the diversity of anthropogenic attractants available to bears.

We developed 4 hypothetical HBI scenarios from which 4 possible management actions could be implemented to test for changes in resident attitudes toward different management actions. These scenarios included: (1) when a bear is frequently sighted in neighborhood, (2) repeatedly disturbs and dumps garbage, (3) destroys personal property, and (4) attacks and injures your neighbor. The 4 management actions used to deal with the scenario in question were (1) no action, (2) use of cracker shells to deter bears, (3) capture and relocation, and (4) lethal removal. We estimated acceptance based on a 5-point acceptance scale of strongly disagree, disagree, undecided, agree, and strongly agree with each management action. We developed a mean support value based on the average number of positive (1; agree and strongly agree), negative (−1; disagree and strongly disagree), and neutral (0; undecided) attitudes to limit the effect of extreme cases and to more intuitively depict attitudes.

The University of Montana Institutional Review Board for human subject research approved this research (Protocol ID# 162-04 in 2004, ID# 170-08 in 2008).

Data analysis

We used Pearson's chi-square (χ^2) tests to examine differences in the frequency of behaviors between

Table 1. Non-response analysis for a questionnaire sent to residents in Rattlesnake Valley, Missoula, Montana, USA, in 2008 to determine behavior and attitudes related to human–black bear interactions. Variables are presented as the percent of respondents, and the mean support value is for a scenario where a bear attacks and injures a neighbor.

Survey question	Respondents ($n = 560$)	Non-respondents ($n = 32$)	Test statistic		
				df	P
Presence of bird feeders			$\chi^2 = 0.339$	1	0.560
Yes	35.5	40.6			
No	64.5	59.4			
Presence of peach tree			$\chi^2 = 1.429$	1	0.232
Yes	2.6	6.1			
No	97.4	93.9			
Presence of cherry tree			$\chi^2 = 1.433$	1	0.231
Yes	16.2	24.2			
No	83.8	75.8			
Mean support value					
No action	−0.84	−0.76	$t = -0.585$	26	0.564
Cracker shells	0.30	0.24	$t = 0.296$	22	0.770
Relocation	0.74	0.86	$t = 1.259$	34	0.217
Lethally remove	0.09	−0.23	$t = 1.606$	27	0.119

2004 and 2008 to test whether resident behaviors that produce attractants changed. We used independent samples *t*-tests assuming unequal variances (Zar 1999) to test for changes in mean support values for different management actions. We tested non-response bias in the 2008 survey by comparing responses of respondents and non-respondents using Pearson's χ^2 tests for behaviors and independent samples *t*-tests assuming unequal variances for attitudes. To test for sampling bias between surveys, we used a χ^2 test of homogeneity (Ott and Longnecker 2001) to test differences in gender, age, and education of respondents. When respondent demographics differed significantly between surveys, we weighted mean support values from the 2008 survey to reflect demographic sampling proportions in the 2004 survey and analyzed them separately. We used a significance level of 0.05 for all statistical tests.

Results

A non-response bias was not detected in the 2008 survey (Table 1). However, respondent demographics varied between the 2004 and 2008 surveys (Table 2). The 2008 survey was skewed toward males, older respondents, and lower education levels, when compared to the 2004 survey (Table 2). Patterns of change using weighted responses between the 2004 and 2008 surveys did not differ from unweighted responses for frequency of bird feeders ($\chi^2 = 0.920$, 1df, $P = 0.338$), BBQ grills ($\chi^2 = 0.231$, 1 df, $P = 0.631$), compost piles ($\chi^2 = 1.706$, 1 df, $P = 0.191$), garbage storage ($\chi^2 = 8.571$, 1 df, $P = 0.003$), and pet food storage ($\chi^2 = 1.390$, 1 df, $P = 0.238$), and mean support values averaged across scenarios for no action ($t = 2.06$, 888 df, $P = 0.053$), cracker shells as a deterrent ($t = 5.23$, 777 df, $P < 0.0001$), capture and relocation ($t = 6.97$, 730 df, $P < 0.0001$), and lethal removal ($t = 6.09$, 978 df, $P < 0.0001$). Therefore, we report unweighted results hereafter for more intuitive interpretation.

Attractants available to bears within the study area were diverse. From the 2008 survey, 63.9% of residents had ≥1 fruit tree and 64.7% of residents had ≥1 berry bush, representing >3 varieties of fruit trees and 8 species of berry bushes. Apple was the most prevalent fruit tree, and mountain ash (*Sorbus sitchensis*) was the most prevalent berry bush (Table 3). Bird feeders, BBQ grills, compost piles, garbage containers, and pet food (Table 4) also occurred on resident properties, along with gardens (44.9%) and outdoor chicken coops (1.3%).

Between 2004 and 2008, frequencies of self-reported human behavior that produce available bird feeders, pet food, compost, and BBQ grills did not change significantly, but the frequency of outdoor garbage storage decreased by 7.6% ($\chi^2 = 8.677$, $P < 0.003$; Table 4). The number of residents who reported they stored their garbage outdoors decreased by 33% from 2004 to 2008 (Table 4).

Table 2. Respondent demographics from mail questionnaires implemented in 2004 and 2008 to Rattlesnake Valley residents, Missoula, Montana, USA, to test for changes in human behavior and attitudes. Data are represented as percent of respondents reporting the corresponding demographic parameter.

	Survey					
				Test statistic (2004 vs. 2008)		
Variable (n = 2004, 2008)	2004	2008	Mean (weighted)		df	P
Gender (366, 558)				χ^2 = 24.32	1	<0.0001
Male	48	65	59			
Female	52	35	41			
Age (366, 563)				χ^2 = 40.41	5	<0.0001
18–25	5	1	2			
26–35	12	8	9			
36–45	16	12	14			
46–55	28	21	24			
56–65	18	29	25			
>65	20	29	26			
Education (363, 563)				χ^2 = 9.439	4	<0.0001
Some high school	2	0	1			
High school	4	6	5			
Some college	20	17	18			
Bachelor's degree	33	37	36			
Graduate degree	41	40	40			

Acceptance based on mean support values across all conflict scenarios increased between 2004 and 2008 for the use of cracker shells as a deterrent (t = 4.67, 813 df, $P <$ <0.0001), capture and relocation (t = 6.46, 796 df, $P < 0.0001$), and lethal removal (t = 7.07, 886 df, $P < 0.0001$; Fig. 1). The proportion of residents responding with positive attitudes increased, depending on bear incident scenario, by 9–21% for cracker shells, 0–25% for capture and relocation, and 6–27% for lethal removal (Fig. 1a–d), but did not change significantly for no action (t = 1.89, 852 df, P = 0.058; Fig. 1e). Mean support values were highest for capture and relocation (47–89% of residents supported relocation) depending on conflict scenario. Mean support values were lowest for lethal removal (3–55% of residents supported lethal removal) depending on conflict scenario (Fig. 1a–d).

Discussion

Monitoring trends in human behavior and attitudes is an important aspect of successful wildlife management (Decker and Enck 1996). Indeed, monitoring is fundamental to understanding shortcomings and the usefulness of proactive management actions such as IEE to manage the increasing prevalence of HBI (Gore et al. 2006). The results of our case study provide a quantitative description of the diversity of attractants based on self-reported behaviors, and 1 of the only temporal examinations of behavior and attitudes of residents exposed to

Table 3. Frequency of occurrence of vegetation attracting black bears to resident properties, Rattlesnake Valley, Missoula, Montana, USA. Values are self-reported from a mail questionnaire implemented in 2008.

Fruit trees		Berry bushes			
		Native		Non-native	
Type	%	Type	%	Type	%
Apple	50.4	Mountain ash	33.6	Raspberry	26.3
Cherry	16.2	Serviceberry	23.1	Strawberry	13.7
Pear	11.3	Elderberry	9.0	Grape	6.4
Peach	2.6			Holly	6.4
Other	24.1			Blueberry	2.6

Table 4. Frequency of outdoor black bear attractants based on self-reported resident behavior in the early stages of information and education efforts (2004) and 4 years later (2008) in the Rattlesnake Valley, Missoula, Montana, USA. *P*-values are based on a chi-square (χ^2) test of homogeneity of frequencies between surveys.

	Survey			
	2004	2008	χ^2	*P*
Bird feeder	38.9	35.5	1.06	0.302
BBQ grill	77.7	74.2	1.32	0.250
Compost pile	19.5	16.6	1.25	0.263
Garbage storage	22.7	15.1	8.68	0.003
Pet food storage	0.3	0.7	0.33	0.565

HBI and an IEE. In general accordance with our expectations, the prevalence of one important behavior (i.e., outdoor garbage storage) decreased, and support for management actions used to deal with HBI increased, suggesting some behaviors and attitudes of residents changed from 2004 to 2008. Implications herein suggest that proactive management plans for HBI must embrace the diversity of attractants available to bears and the shifting dynamics of human behavior and attitudes.

The diversity and abundance of bear forage located in our study area supports how difficult it is for bear managers to reduce the availability of attractants. In addition to non-vegetative anthropogenic attractants such as garbage, bird feeders, and BBQ grills, native and non-native black bear forage were widespread. Apple trees were the most prevalent bear-attracting vegetation species in our study area. In addition, >4 species of native berry and >7 other fruit producing species also were present (Table 3). Because black bear foraging dynamics are closely related to seasonal shifts in available food (Rogers 1987), proactive management plans to eradicate specific attractants (e.g., only garbage) may not affect the frequency of HBI. However, if proactive management plans succeed in substantially reducing the availability of numerous anthropogenic foods, little or no information is available on the biological response of bears. When garbage dumps (the only anthropogenic food source for bears) were eliminated in Yellowstone National Park, human–grizzly bear (*U. arctos*) interactions increased and numerous bears were euthanized, which played a role in a significant population decline and redistribution (Knight and Eberhardt 1985, Eberhardt et al. 1986). We recommend that the diversity of attractants and the biological effects of eliminating multiple attractants be incorporated into proactive management plans and suggest that researchers should assess the impacts of the removal of anthropogenic food (e.g., garbage or apple trees) on bear habitat use, movements, and population dynamics.

Underlining the presence of anthropogenic food sources is human behavior (Baruch-Mordo et al. 2009), where residents carry out intended or unintended behavioral actions (e.g., decide to put out their garbage the night before garbage pick-up) that provide anthropogenic food sources to bears. One of the main goals in proactive bear management is to preventatively reduce the prevalence of anthropogenic food sources. To our knowledge, the authors of only 1 other study monitored behavior of residents exposed to HBI. Gore et al. (2008) found no differences in self-reported prevalence of unsecured garbage, outdoor feeding of pets, outdoor storage of BBQ grills, compost piles, bird feeders, and failure to harvest fruit from trees over 1 year after the implementation of IEE in New York. Our results are consistent with some of these findings, where no changes in human behavior were reported for the presence of outdoor bird feeders, composts, gardens, and pet food storage. However, in contrast to the New York study, we found a decrease in self-reported change in the frequency of garbage containers stored outside (Table 4). Discrepancies between self-reported behavioral change in New York and this study may be the result of different time frames (1 year in New York versus 4 years in this study) or differences in resident exposure to IEE or other bear-related information.

It seems clear that North American public attitudes have become more protectionist and less utilitarian (Manfredo et al. 1999), emphasized by public disapproval of black bear hunting techniques (Teel et al. 2002) and ballot initiatives limiting hunting seasons and methods (Manfredo et al. 1998). Our results suggest an alternate trend, where support for the use of cracker shells, relocation, and lethal removal as management tools for dealing with HBI have increased over time. Our findings correspond more closely to a 17-year meta-analysis of studies in New York, which found no trend across demographic segments toward a more protectionist society, and recommended that more research is needed to identify mechanisms of change (Butler et al. 2003). Regardless, our results do reemphasize that non-lethal management tools, especially relocation,

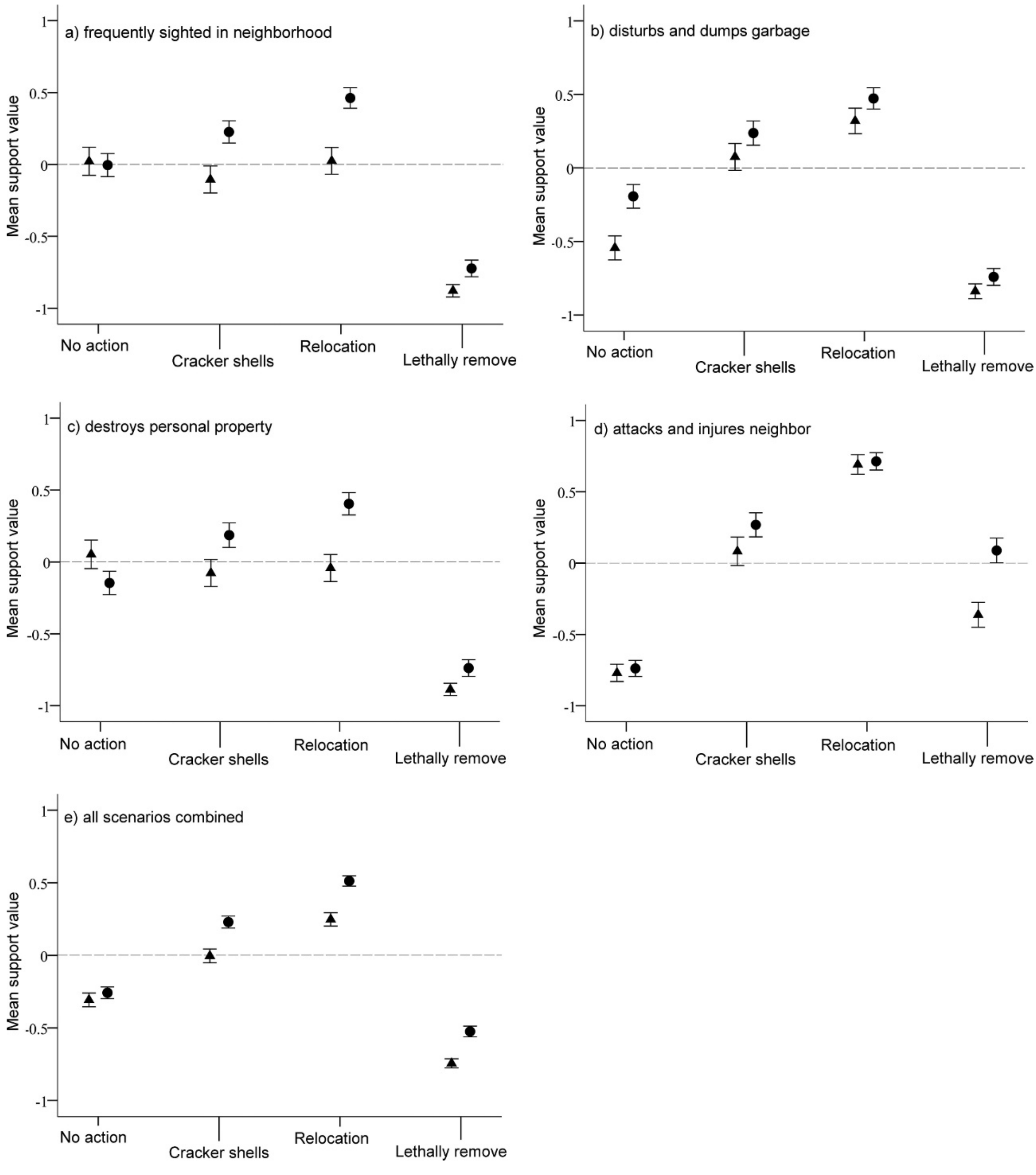

Fig. 1. Support values based on the mean of positive (1 = agree and strongly agree), neutral (0 = neutral), and negative (−1 = disagree and strongly disagree) attitudes for different management actions to reduce HBI between 2004 (triangles) and 2008 (circles) in the Rattlesnake Valley, Missoula, Montana, USA. Results are stratified by conflict scenario: (a) bear frequently sighted in neighborhood; (b) bear repeatedly disturbs and dumps garbage; (c) bear destroys personal property; (d) bear attacks and injures your neighbor; and (e) all scenarios combined. Error bars denote 95% confidence intervals around the mean.

have high overall support (Fig. 1e), and that lethal management tools are relatively unsupported (Fig. 1e) except in situations where a human life has been compromised by injury (Fig. 1d). We are not suggesting, however, that relocation is the best reactive management tool; we are merely reporting public support. It is clear that relocation is not always successful and may only temporarily delay reoccurrence of HBI (Landriault et al. 2009).

We propose 2 reasons for the positive trends observed in this study, where 1 human behavior and numerous attitudes changed. First, IEE were being developed in the Rattlesnake Valley between 2000 and 2004 and were consistently being implemented during our study period (2004–2008; J.J. Jonkel, personal communication, 2010). Educational efforts, such as IEE implemented in the Rattlesnake Valley, have played a role in successful implementation of policy directed toward minimizing other human–wildlife interactions (McCarthy and Seavoy 1994, Piene 2001) and have been suggested as a means of altering human attitudes (Coluccy et al. 2001, Enck and Brown 2002, Teel et al. 2002). The IEE implemented in our study area may have been successful in changing resident knowledge of bear biology, conflicts, and management, resulting in more responsible behavior and higher support for management actions used to deal with HBI. Second, the process of mere exposure also affects behavioral and attitudinal change (Zajonc 1968, Petty and Wegener 1998). Residents may have received information from non-IEE avenues, such as articles in newspapers, frequent bear sightings, and discussions with neighbors. Changes in self-reported behavior and attitudes may have also come from exposure to specific conflicts, such as bears getting into individual respondent's garbage containers.

To identify the mechanism for change, future research monitoring human behavior and attitudes and assessing IEE, should incorporate 2 important components. First, studies should include a spatial control, along with a longitudinal framework, to compare resident exposure to treatments such as varying levels of IEE (Gore et al. 2008, Baruch-Mordo et al. 2009). In this study, we did not include a spatial control or monitor the frequency and intensity of IEE, which would have been beneficial for identifying patterns in human behaviors and attitudes and reasons for change (e.g., effectiveness of IEE). Second, receptivity to educational messages such as IEE has been linked to risk perception (Knuth et al. 1992), where people intuitively assess a risk (Slovic 1987). For HBI, risk can be classified by threats to human safety and property damage. This perceived threat to human safety and property must be evident for a risk-reducing behavior to be carried out (Witte 1992). When monitoring behavior and attitudes of residents exposed to HBI and IEE, covariates intended to identify risk perception must be included in the analysis. For example, although no changes were observed due to an IEE in New York, risk perception increased, providing some evidence that IEE was the mechanism for change (Gore et al. 2008). Optimal study designs for monitoring human behavior and attitudes and evaluating IEE will include controls and antecedents for risk perception (Gore et al. 2008), generating the most informative information for developing, modifying, and evaluating proactive management actions for reducing HBI.

Wildlife managers and researchers should take caution when interpreting the results of this study, because we recognize 2 issues related to study design that may have affected our data. First, methods for implementing the 2004 and 2008 surveys were different. Although we randomly selected households in both cases, and we ran our analysis using demographically weighted data, other demographic differences (e.g., whether the resident owns or rents the property) may have played a role in the patterns we observed. Second, we did not assess non-response bias in 2004, and our non-response assessment in 2008 did not evaluate important demographic variables nor did it have a large sample size ($n = 32$).

Management implications

Based on our results, bear managers should consider 3 important components when developing and implementing proactive management plans for reducing HBI. First, the diversity of anthropogenic attractants within local areas may be high (>10 different vegetative or non-vegetative food sources), making it difficult to reduce HBI by decreasing the prevalence of a single attractant. Managers should systematically investigate the diversity and prevalence of attractants within their respective management area and investigate the effects of reducing the availability of a single or multiple attractants. Second, managers should assess the possibility that human behavior and attitudes are changing within areas exposed to HBI and IEE, and incorporate those changes into proactive management initiatives.

Third, to identify shortcomings and evaluate effectiveness of proactive management plans (i.e., IEE), managers must develop monitoring protocols using longitudinal and treatment–control study designs (Gore et al. 2008, Baruch-Mordo et al. 2009). These monitoring protocols, along with a suite of other information such as harvest numbers, removal numbers from conflict mortality and relocations, natural forage availability, weather, and basic biological data, will greatly assist in interpreting IEE outcomes in the future (Gore et al. 2006).

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