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Socioeconomic Factors Affecting Local Support for Black Bear Recovery Strategies

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Abstract

There is global interest in recovering locally extirpated carnivore species. Successful efforts to recover Louisiana black bear in Louisiana have prompted interest in recovery throughout the species' historical range. We evaluated support for three potential black bear recovery strategies prior to public release of a black bear conservation and management plan for eastern Texas, United States. Data were collected from 1,006 residents living in proximity to potential recovery locations, particularly Big Thicket National Preserve. In addition to traditional logistic regression analysis, we used conditional probability analysis to statistically and visually evaluate probabilities of public support for potential black bear recovery strategies based on socioeconomic factors. Allowing black bears to repopulate the region on their own (i.e., without active reintroduction) was the recovery strategy with the greatest probability of acceptance. Recovery strategy acceptance was influenced by many socioeconomic factors. Although impact was limited, older and long–time local residents were most likely to want to exclude black bears from the area. Concern about the problems that black bears may cause was the only variable significantly related to support or non–support across all strategies. Lack of personal knowledge about black bears was the most frequent reason for uncertainty about preferred strategy. In order to reduce local uncertainty about possible recovery strategies, we suggest that wildlife managers focus outreach efforts on providing local residents with information pertinent to minimizing the potential for human–black bear conflict.

Keywords: American black bear; attitudes; conditional probability analysis; human-bear conflict; human dimensions; population recovery; *Ursus americanus*; wildlife management

There is global interest in recovering locally extirpated carnivore species (Reading and Clark 1996; Breitenmoser 1998; Sillero–Zubiri and Laurenson, 2001), which can result in both ecological (Fuller and Sievert 2001; Maehr and others 2001; Vucetich and others 2005) and socioeconomic (Miller and others 1998; Wright 1999; Montag and others 2005) benefits to a region. For example, the reintroduction of wolves in Yellowstone has resulted in ecological restoration (Ripple and Beschta 2003) as well as a popular activity for a majority (86%) of visitors (Manni and others 2007). Wildlife observation is an important motivation for recreation (Stynes and White 2005), for which billions of dollars are spent yearly in the USA alone (Miller and others 1998; Stynes 2005; USFWS, 2007).

Because recovery presents a particular management challenge for species that require large areas of habitat (e.g., Woodroffe 2001; Maehr and others 2001), protected areas (reserves) are often targets for recovery agendas (Fritts and others 1997; Soulé and Sanjayan 1998; Mills and others 2001). However, many reserves are too small to meet the needs of far–ranging species (Newmark 1996; Harcourt and others 2001) and, because wildlife does not recognize geopolitical boundaries, nearby land use may influence the sustainability of wildlife that travels beyond reserve boundaries (Woodroffe and Ginsberg 1998; Rivard and others 2000; Harcourt and others 2001; Parks and Harcourt 2002).

Consideration of local socioeconomic factors that may affect support for a recovery program may increase the probability of success of recovery efforts (Reading and Clark 1996; Clark and others 2002) and survivorship of a species (Liu and others 2001; Parks and Harcourt 2002; Pressey and others 2002; An and others 2005). Even if ecological and socioeconomic benefits of recovery are perceived from a tourism standpoint, tolerance of species presence by local residents, who may interact with a species on a day–to–day basis,

is necessary for recovery success (Reading and Clark 1996). Existing empirical data about local support for carnivore recovery programs vary greatly, which suggests both a need for more information related to human dimensions aspects of carnivore recovery management, and easily understandable methods for presenting scientific data. Specifically, we are unaware of any research that evaluates support for particular management strategies in locations where black bears have not existed for several decades. To add to our knowledge, we evaluated attitudes of local residents toward recovery strategies for the Louisiana black bear (*Ursus americanus luteolus)* in eastern Texas and, while doing this, demonstrate a novel application of a conditional probability–based analysis.

Return of the Louisiana black bear

The Louisiana black bear was nearly extirpated from the south–central USA as a result of over–harvest and habitat loss (BBCC 1997). Following a public outreach campaign during the 1990s, recovery is underway in Louisiana (Bowker and Jacobson 1995; BBCC 1997). Although no breeding population exists in eastern Texas, a recent increase in the number of black bear sightings (likely transients from neighboring states) has prompted creation of a black bear management plan, the goal of which is to restore habitat for the purpose of reestablishing a black bear population (TPWD 2005).

One potential black bear recovery site in eastern Texas is Big Thicket National Preserve (BTNP). Although highly suitable black bear habitat exists within BTNP (Garner 1996), the nine land and river corridor management units (39,256 ha total) are not large enough to support a black bear population. As a result, black bears likely would move out of the reserve and inadvertently come into contact with local residents.

Conceptual background: human dimensions of carnivore management

In the context of carnivore management, attitudes are positive or negative responses to a particular species (Fulton and others 1996; Decker and others 2001). Both negative and positive attitudes are associated with carnivores (Bath and Buchanan 1989; Schoenecker and Shaw 1997; Peyton and others 2001; Enck and Brown 2002; Bowman and others 2004). Although species vary ecologically and behaviorally, people respond fairly similarly toward large carnivores in general (e.g., Kellert 1985; Kellert and others 1996; Kleiven and others 2004). Attitudes toward black bears are generally positive (Kellert 1994; Morzillo and others 2007a), even in instances of human–bear conflict (Jonker and others 1998; Bowman and others 2001), and several researchers have assessed attitudes toward augmenting existing black bear populations (Peyton and others 2001; Siemer and Decker 2003) and reintroductions (Bowman and others 2001; Bowman and others 2004).

In eastern Texas, earlier analysis suggests that most respondents do not want to exclude black bears from the area, but uncertainty existed as to whether humans should assist recovery (i.e., reintroduction; Morzillo and others 2007b; Table 1). Consequently, our objective here was to expand on our earlier work by examining support for particular black bear recovery strategies. To do this, we used, in addition to standard methods, a novel application of conditional probability analysis in order to evaluate the probability of acceptance of recovery strategies relative to socioeconomic factors. Based on past research related to recovery of carnivore species (e.g., Schoenecker and Shaw 1997; Bowman and others 2004; Morzillo and others 2007a,b), we hypothesized that socioeconomic

characteristics such as sex, length of local residency, and knowledge about black bears, would be factors contributing to support (or lack thereof) for different recovery strategies.

Methods

Study area, sample selection, and survey implementation

Our study area (25,372 km^2) consisted of 12 counties in eastern Texas (US; Fig. 1). The resident population is approximately 500,000 (US Department of Commerce (USDC) Census Bureau 2006). A majority of the area is rural, forested, and interspersed with small towns, with most of the landscape managed privately for timber (approximately 50%) or managed by the US government (approximately 25%; BTNP and four National Forests).

We used ArcView GIS 3.2 (Environmental Systems Research Institute, Inc., Redlands, CA, USA) and population density information from the US Census Bureau (USDC 2006) to divide the study area and control sample size selection among 3 mutually exclusive strata (Kalton 1983; Sheskin 1985): rural, urban, and suburban. The rural and urban strata were created based on US Census Bureau definitions (rural: < 193 people per km^2 (< 500 people per $mile^2$) and villages with populations of < 2,500; urban: ≥ 193 people per km^2 (≥ 500 people per $mile^2$) and towns containing a population of ≥ 2,500 people; USDC 2006). Residents within these two strata were distributed irregularly across the study area. The suburban stratum was limited to the southern edge of the study area and consisted of sprawling development from the Houston metropolitan area.

A modified version of the Tailored Design Method (Dillman 2000) was applied to survey design and implementation, which consisted of multiple mailings (prenotice, two survey mailings, and reminder postcard) and an incentive (two first−class postage stamps)

to increase response rate. In January 2004, a questionnaire was mailed to approximately 1% of the study area's adult population (n = 3,000). The survey sample was randomly selected from within each of the three strata in the following proportions: (1) rural (n = 2 000), (2) urban (n = 600), and (3) suburban (n = 400). We chose these sample sizes to maintain sufficient samples for all three strata as determined by anticipated sampling error (Kalton 1983; Sheskin 1985). Because black bears prefer remote forested areas (Pelton 2003), we assumed that rural residents would have the greatest probability of contact with black bears. Thus, we used disproportionate sampling of the strata (Kalton 1983) to oversample (Kalton 1983; Sheskin 1985) and adequately represent the less–populated rural stratum. As a result of oversampling the rural stratum, sample sizes of the other two strata were reduced to maintain our desired initial N of 3,000. The population of the urban stratum was approximately 50% larger than the population of the suburban stratum; therefore, we allocated 600 surveys to the urban stratum and 400 to the suburban stratum to match the relative population distribution for these two strata. Name and address information was purchased from Survey Sampling, Inc. (Fairfield, Connecticut, US). The University Committee on Research Involving Human Subjects at Michigan State University (East Lansing, Michigan, US; IRB #02–155) granted permission for use of human subjects.

Dependent variables

Three dependent variables represented support for three different management strategies related to recovery: natural recovery without human assistance (*Natural*), human–assisted reintroduction (*Assist*), and excluding black bears (*No bear*).

Natural. –Respondents were asked, "Do you think black bear populations in East Texas should increase naturally?" *Natural* referred to passive recovery without assistance from managers. This would entail habitat management, but black bears would have to repopulate the area on their own (TPWD 2005). Responses were coded such that higher scores indicated more support (support = 2, unsure = 1, no support = 0).

Assist. –Respondents were asked, "Do you think that natural resource agencies should assist in increasing the black bear population size in East Texas?" Specific means of assistance were not provided. This active strategy would entail habitat management followed by a physical release of black bears into the area by managers (TPWD 2005). Responses were coded such that higher scores indicated more support (support = 2, unsure = 1, no support = 0).

No bear. –Respondents were asked whether they agreed or disagreed with the statement "black bears should not exist in southeast Texas." Agreement with this statement would imply support for active efforts to exclude black bears from the area. Support for *No bear* was evaluated using a Likert–scale format (Babbie 1990); responses were coded so that higher values indicated more support for excluding black bears from the area (5 = strongly agree; 1 = strongly disagree). Variation in format of *No bear* was a result of its inclusion in a different part of the survey, with formatting consistent with adjacent questions in order to avoid respondent confusion.

Independent variables

Seventeen independent variables focusing on respondent demographics and familiarity with black bears were developed from survey questions (Table 2): (a)

community type (e.g., urban, rural), (b) number of children (< 18 years of age) in household, (c) pets (i.e., own pets or not?), (d) sex, (e) age, (f) education (i.e., highest formal level completed), (g) household income, (h) membership in wildlife–related organizations (i.e., member or not?), (i) participation in utilitarian activities related to wildlife (described below), (j) participation in passive–appreciative activities related to wildlife (described below), (k) tenure (i.e., residential tenure), (l) livestock ownership (i.e., own livestock or not?), (m) number of acres owned, (n) knowledge about black bears (described below), (o) having seen a black bear in the wild, (p) wanting black bears in the area (*Want*, described below), and (q) worry about the problems that black bears may cause (*Worry*, described below). Most of these variables were measured using single questionnaire items. However, three independent variables (2 activity variables and knowledge) were composites of separate items from the survey, and the *Want* and *Worry* variables were derived from the same survey question.

Activities. –Respondents were asked to report on a three–point scale (3 = often, 2 = sometimes, 1 = never) their participation in 16 activities that hypothetically could put them in contact with black bears or give them greater information about black bears: (a) hiking, (b) jogging/running outside, (c) biking (trail/mountain/road), (d) camping (tent/trailer/RV), (e) motorboating/jetskiing/waterskiing, (f) canoeing/kayaking, (g) riding motorized all–terrain vehicles, (h) reading about wildlife, (i) watching wildlife TV shows or movies, (j) observing or studying wildlife outdoors, (k) hunting big game (e.g., deer), (l) hunting small animals (e.g., squirrel), (m) fishing, (n) working on a farm or ranch, (o) working in the timber industry, and (p) working in the oil/gas industry. Principal components analysis (Fabrigar and others 1999) was used to reduce activities into a smaller number of variables

for analysis. Cronbach's alpha (α) was used to verify appropriateness of combining survey items into a single variable for analysis (Cortina 1993). We derived a scale score by summing responses for items that factored together.

Knowledge. –Respondents were asked to indicate (yes or no) whether prior to the survey they had been aware of each of the following 6 factual statements about black bears in the region: (a) until the early 1900s, eastern Texas contained a large population of black bears, (b) the number of black bear sightings in eastern Texas has increased during the past decade, (c) black bear populations are increasing in size in [the neighboring states of] Arkansas, Louisiana, and Oklahoma, (d) black bears in Texas are protected by both federal and state legislation, (e) black bears exist throughout most of the United States and North America, and (f) black bears are mainly vegetarians. A score of 1 was assigned for each "yes" indicated by the respondent, and a 0 for each "no." A knowledge scale score was calculated by summing up the response scores for each item.

Want and *Worry*. –Respondents were asked to select one statement, from among the following, that best reflected how they felt about black bears in East Texas: (a) "I <u>would</u> enjoy having black bears around AND I would <u>not</u> worry about problems they may cause," (b) "I <u>would</u> enjoy having black bears around BUT I <u>would</u> worry about the problems they may cause," (c) "I would <u>not</u> enjoy having black bears around BUT I would <u>not</u> worry about problems that they may cause," (d) "I would <u>not</u> enjoy having black bears around AND I <u>would</u> worry about problems they may cause," and (e) "I have no particular feelings about black bears regardless of problems caused or not caused by them." For *Want*, if a respondent answered (a) or (b), a score of 1 was assigned to indicate that the respondent would enjoy having black bears in the area. Conversely, if a respondent answered (c) or

(d), a score of 0 was assigned to indicate that the respondent would not enjoy having black bears in the area. For *Worry*, if a respondent answered (b) or (d), a score of 1 was assigned to indicate that the respondent would worry about the problems that black bears may cause. Conversely, if a respondent answered (a) or (c), a score of 0 was assigned to indicate that the respondent would not worry about the problems that black bears may cause. Respondents who answered (e) did not receive a value for *Want* or *Worry*.

Non–response follow–up

To test for possible non–response bias, a follow–up survey (n = 1,600) was sent to all individuals within the survey sample who did not return a survey, excluding those who indicated that they did not wish to participate or for whom we had incorrect addresses. Non–respondents were asked 10 key questions from the actual survey.

Descriptive and multivariate analyses

SPSS 16.0 (SPSS, Inc., Chicago, Illinois, USA) was used to complete statistical analyses. Weights were applied to descriptive analyses in order to allow for examination of the entire survey sample as a whole (Kalton 1983; Babbie 1990). To test the influence of socioeconomic factors on each of the dependent variables, multinomial logistic regression was used for each dependent variable (Babbie 1990; Sokal and Rohlf 1995). Because the dependent variables were ordinal, we first ran ordinal logistic regression; however, our results violated the assumption of parallel lines (i.e., that the effects of the independent variables are the same for each category of the dependent variable). Alpha values were

246 defined at the 95% confidence interval. Odds ratios (Exp(β)) were used to assess the
247 strength of variable relationships (Sokal and Rohlf 1995).
248
249 ***Conditional probability analysis (CPA)***
250 We used the R Language for Statistical Computing for all conditional probability
251 analyses (R Development Core Team 2008; Hollister and others 2008; online supplemental
252 material). Conditional probability analysis (CPA) has been used in other environmental
253 science applications (Paul and McDonald 2005; Hollister and others 2008), and presents
254 results in a manner easily adaptable to the needs of resource managers.
255 Conditional probability (CP) was calculated as the ratio of the joint probability of Y
256 and X to the probability of X (Equation 1).

257 $$P(Y \mid X) = \frac{P(Y, X)}{P(X)} \quad (1)$$

258 In this analysis, Y was the probability of accepting a given recovery strategy. We
259 converted *Natural* and *Assist* to a binary response ("Support" and "No support/Unsure").
260 We converted *No bear* responses to a binary probability of acceptance (i.e. accepting that
261 black bears should not exist) by reclassifying response greater than or equal to 4 (i.e.
262 "Strongly Agree" and "Agree") into one "Agree" response and responses less than or equal
263 to 3 ("Unsure", "Disagree", and "Strongly Disagree" into one "Disagree" response. In all
264 cases, probability of acceptance was calculated as the number of "acceptance" responses
265 divided by the total number of responses.
266 The socioeconomic factors determined the probability of X. In the original
267 environmental applications of CPA (Paul and McDonald 2005; Hollister and others 2008),

X is defined as $X > X_c$ where the X value was not to be exceeded. In this study, we treated all variables as categorical and defined X as $X = X_c$. For example, the CP of accepting the *Assist* strategy based on gender was calculated for males and females separately. Continuous variables (age, tenure, and acres owned) were converted into categorical factors. For age and tenure, a value of one was assigned for respondents whose scores were more than one standard deviation less than the mean (age < 41 or tenure < 21), a value of two was assigned for respondents with scores within one standard deviation of the mean (age ≥ to 41 and ≤ 69 or tenure ≥ to 21 and ≤ 56), and a value of three was assigned for respondents with scores more than one standard deviation greater than the mean (age > 69 or tenure > 56). The response distribution for acres owned was skewed right; thus the classes were assigned using the 33^{rd} and 66^{th} percentiles instead of mean and standard deviation (≤ 2 acres assigned a 1, between 2 and 10 acres assigned a 2, ≥ 10 acres assigned a 3).

To estimate statistical differences between CP of accepting a recovery strategy, we drew one thousand bootstrap samples (Manley 2007; Hollister and others 2008), and used boxplots to illustrate the distribution of the probabilities for each independent variable. Non–overlapping 95% confidence limits indicated a statistical difference in the CP of acceptance.

It is important to note that CPA is answering slightly different questions than multinomial logistic regression. First, the response is a binary choice (i.e. probability of acceptance) and not a choice among three or more possibilities, as in multinomial logistic regression. Second, CPA considers independent variables separately. Although CPA

simplifies interpretation, it does not account for the concurrent influence of explanatory variables. In short, the two analyses complement but do not duplicate each other.

Results

The overall response rate was 40% (n = 1,006 of 3,000) after removing wrongly identified addresses from the original sample size. Demographic characteristics (income, education, sex) for those responding to the initial survey (n = 1,006) were similar to characteristics of those who responded to the non–response follow–up survey (n = 163). Self–reported lack of knowledge about black bears (45%) or a dislike for answering surveys (24%) were the two most common reasons for survey non–response.

Data reduction of "activities" variables

Six activities loaded together as "utilitarian activities" (32% of the overall variance in all activities was explained by this factor; $\alpha = 0.84$; rotated factor loading scores in parentheses): camping (0.699), boating (0.796), all–terrain vehicle use (0.521), hunting big game (0.601), hunting small game (0.582), and fishing (0.749). Three activities loaded together as "passive–appreciative activities" (9% of the overall variance; $\alpha = 0.79$): reading about wildlife (0.809), watching wildlife–related TV shows or movies (0.832), and wildlife observation (0.766). We eliminated the remaining 7 activities from further analysis.

Sample characteristics

More than half of all respondents described their residential setting as rural area or small town, own pets, are male, and have a household income of ≥ $40,000 (Table 2).

Other characteristics included averages of <1 child per household (SD = 1.03) and age of 54 years old (SD = 15.11). Twenty–six percent of respondents had at least a college degree. Few respondents were members of wildlife–related organizations, but many participated in utilitarian and passive–appreciative activities. On average, respondents had a residential tenure of > 38 years (SD = 19.25) and owned 22 acres of land (SD = 84.14); 14% tend livestock. The average knowledge score was 2.48 (SD = 1.77) out of 6. About one quarter of respondents had seen a bear in the wild. More than half of respondents reported that they would like having black bears in eastern Texas; 19% would not. Half of respondents worried about the problems that black bears may cause; 34% did not.

Factors influencing support for recovery strategies

Multinomial logistic regression was used for each dependent variable. For *Natural* (Table 3a), respondents with more kids at home, males, those with higher incomes, more frequent participants in utilitarian and passive−appreciative activities related to wildlife, and those who worry less about the problems that black bears may cause were more likely to choose "no support" than "support." No independent variables were significant when comparing "unsure" versus "support."

For *Assist* (Table 3b), respondents who were female, were less frequent participants in passive−appreciative activities related to wildlife, did not want black bears in East Texas, and worried more about the problems that bears may cause were more likely to choose "no support" than "support." The same characteristics, plus less knowledge about black bears, were found among those who were more likely to choose "unsure" than "support." In some cases, respondents who were more likely to support *Assist* (a more aggressive recovery

strategy) were less likely to support *Natural* (i.e., men, more frequent participants in passive−appreciative activities related to wildlife, and those who worry less about the problems that black bears may cause).

For *No bear* (Table 3c), respondents who were more knowledgeable about black bears and those more likely to want bears in the area were more likely to choose "strongly disagree" than any other response. Respondents who were more likely to worry about the problems that bears may cause tended to select any response other than "strongly disagree" for this strategy. Those who have not seen a bear in the wild and older respondents were more likely to select either "disagree" or "unsure" than to select "strongly disagree." Respondents in more urban locations, with more formal education, and participate more in utilitarian activities were also more likely to choose "disagree" than "strongly disagree."

Conditional probability analysis

The bootstrapped 95% confidence limits of the unconditional probabilities of accepting a given recovery strategy (i.e. probability of acceptance without regard for independent variables) were 0.379 to 0.439, 0.289 to 0.348, and 0.233 to 0.290 for *Natural, Assist,* and *No bear*, respectively. Deviation from these confidence limits indicates a significant effect of the socio-economic factors on probability of acceptance (Fig. 2a, b ; online supplemental material). There was a large degree of consistency between the results of the multinomial logistic regression (Tables 3a−c) and CPA (Fig. 2a, b; online supplemental material). Independent variables that showed significant differences between the unconditional probabilities and the CPs of acceptance were utilitarian activities and worry for *Natural*; sex, organization member, utilitarian activities, passive–appreciative

activities, knowledge, see bear, want, and worry for *Assist*; and number < 18, age, income, utilitarian activities, passive–appreciative activity, tenure, knowledge, see bears, want, and worry for *No bear* (Fig. 2; online supplemental material). Differences also existed in the CPs across strategies (Table 4). Only the *Assist* strategy showed a difference for sex. In contrast, the response for *Natural* and *No bear* are not different than the unconditional probability, yet a higher rate of acceptance by females is suggested for both. Several variables display no dynamic trends.

Discussion

Few studies have evaluated socioeconomic factors affecting support for different carnivore recovery strategies. We examined such factors using a survey of resident attitudes toward potential black bear recovery in East Texas, and augmented standard social science analyses with a novel application of CPA analysis. Both analyses suggested that support for each recovery strategy was influenced by socioeconomic variables; this is consistent with past black bear research (e.g., Bowman and others 2004; Peyton and others 2001). Combining logistic regression and CPA allows us to complement rigorous statistical analysis with visually friendly results.

Broadly, allowing black bears to repopulate the region on their own was the recovery strategy with the greatest probability of acceptance. Socioeconomic and demographic characteristics affected support for each strategy, and were relatively more apparent in CPA results for *Assist* and *No bear* than for *Natural*. Some of our individual independent variable relationships contrasted with results from other studies. For example, community type was not a strong predictor of support in our study, whereas others have

reported direct positive relationships between community size and recovery support (Lohr and others 1996; Bowman and others 2004). Females were less likely to support *Assist* in our study, which differs from potential reintroductions in other locations (e.g., Lohr and others 1996). We were surprised that age and tenure had limited impact across all strategies, but results for *No bear* corroborate findings of other carnivore studies (Bowman and others 2004; Schoenecker and Shaw 1997). Several life–long area residents noted on our survey that they remember their elders speaking of human-black bear conflict and black bears killing livestock. Such tales may have instilled a negative perception if black bears in the past were perceived as nuisances or dangerous (Reading and Kellert 1993), resulting in greater concerns about safety, wildlife–human conflict, or change in general often found among older residents (Kellert 1985; Bath 1989; Bowman et al. 2004). Ultimately, long-time residents may feel uncertain about the prospect of significant change in the landscape.

Similar to Morzillo and others (2007a) and other studies (e.g., Bowman and others 2001; Mertig 2004), we expected knowledge about black bears to be an important influence in support for recovery. Though our expectation was met only for *No bear* and unsure−support comparison of *Assist*, CPA revealed an interesting and easily interpretable trend between knowledge about black bears and support for each recovery strategy (Fig. 2a) that went unnoticed using multivariate analysis. For *Assist*, probability of support was less than the sample as a whole for knowledge levels 0−2, but higher than the sample as a whole for knowledge levels > 3. This trend was reversed for *No bear*, but did not exist for *Natural*. These results suggest that knowledge about black bears influences attitudes toward acceptance or non-acceptance of particular recovery strategies, and those with more knowledge about black bears are more likely to support an active recovery strategy.

Although people are generally more familiar with black bears than other large mammals (Kellert 1994; Bowman and others 2001), knowledge about and attitudes toward carnivore species are not always consistent (e.g., Lohr and others 1996; Brooks and others 1999). In our survey, indecision about support for *Natural* and *Assist* strategies was accompanied by volunteered reasons such as "I don't know anything about bears," or "I don't know enough about bears to make an informed decision." This also likely contributed to non–response and influenced concern about bear–related problems (significant negative correlation between *Knowledge* and *Worry* of $r = -0.240$, $p < 0.001$). Ultimately, general knowledge about black bears appears to be a particularly important focus for outreach if a relatively aggressive recovery strategy is sought by managers (i.e., *Assist*), as even small increases in local knowledge about black bears may influence support for recovery.

It is important to note that *worry* was the most consistently significant independent variable across all recovery strategies, and CPA results illustrated the largest difference in responses for *Assist* (Fig. 2b). Elsewhere on our survey, respondents voluntarily indicated "concerns about garbage," "pilfering human areas for food," and "feeding by humans" as anticipated nuisance problems. Local concern about human–wildlife conflicts has been documented in other carnivore studies (Peine 2001; Enck and Brown 2002; Lee and Miller 2003); some conflict between black bears and humans is likely to occur in eastern Texas. Sixty–three percent of respondents requested informational brochures about black bears and how to minimize potential for conflict (e.g., feed household pets indoors rather than outdoors), which suggests some interest in the ability to adapt to black bear presence despite concern about possible problems. Ultimately, the *Natural* strategy may allow

residents to feel as if they have some control over the recovery process relative to their individual lifestyle. Lessons from other locations may help both residents and managers deal with problem bears and constituent concerns. For example, Massachusetts black bear managers and farmers found that electronic fencing was most effective for deterring black bears from property (Jonker and others 1998). By linking landowner experience in other locations to local concern, managers can provide residents with information that will help proactively minimize reasons for black bears to become attracted to human activity.

Comparison of logistic regression and CPA output also revealed differences between the results of the two analyses. One example is the effect of utilitarian activities on *Assist*. Although the effect size was not significant in logistic regression, a very strong direct relationship was revealed in CPA between participation in utilitarian activities and probability of accepting *Assist*. Utilitarian activities include participation in a consumptive wildlife−related setting (camping, boating, hunting big and small game, and fishing; Morzillo and others 2007a). It is possible that the trends in utilitarian activities that appear in CPA may be explained away by other variables or variable relationships in logistic analysis (Cramer 2003).

Our results provide managers with baseline information about recovery support, concerns, and uncertainty that may be used to identify target audiences for further public outreach efforts. Complementing logistic analysis with visually friendly CPA may be more useful than statistical output alone, particularly when presenting results to the general public. For instance, outreach emphasis on providing even a small amount of information about black bears may be effective at helping residents make informed decisions about management actions and future black bear recovery policy (McFarlane and others 2006).

However, there is no guarantee that outreach and related information will result in either increased local knowledge about black bears (Bowman and others 2001) or greater support for recovery (Bright and Manfredo 1995; Lohr and others 1996; see also Morzillo and others 2007a). Some residents never will support recovery, but learning more about the conditions that determine reasons for opposition or uncertainty may prove valuable for conservation planning.

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703 **Captions for Figures**

704

705 Fig. 1. The 12–county region in eastern Texas, from which survey participants were
706 selected, used to assess variables affecting resident attitudes toward potential black bear
707 recovery strategies. These counties include and surround Big Thicket National Preserve
708 (shaded areas within the ellipse).

709

710 Fig. 2. Boxplots of bootstrapped probabilities of accepting three LBB reintroduction
711 strategies (Natural, Assist, and No bear) conditioned upon the variables (a) knowledge and
712 (b) worry. Box represents the 25th and 75th percentiles, whiskers represent 95%
713 confidence limits, and black line within box represents the median. Grey lines represent
714 probability of acceptance of population as a whole. Whiskers outside of grey lines indicate
715 a significant difference in probability of acceptance. Widths of boxes are proportional to the
716 square root of sample size for each factor (i.e. wider boxes = greater sample size). Blank
717 categories indicate that sample sizes were inadequate for calculating accurate probabilities.
718 Boxplots for all other independent variables are available in online supplemental materials.

719

720 Figure 1.

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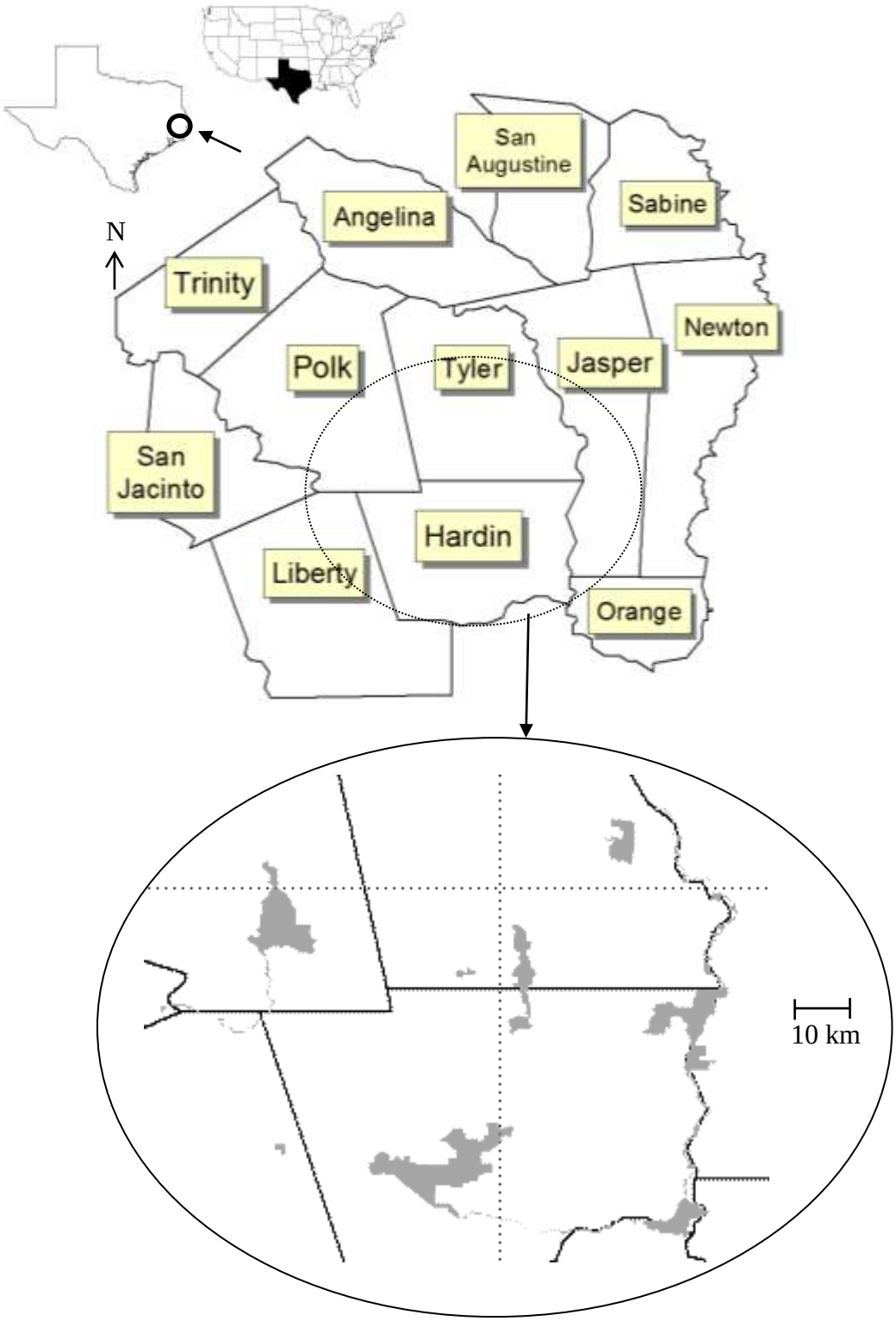

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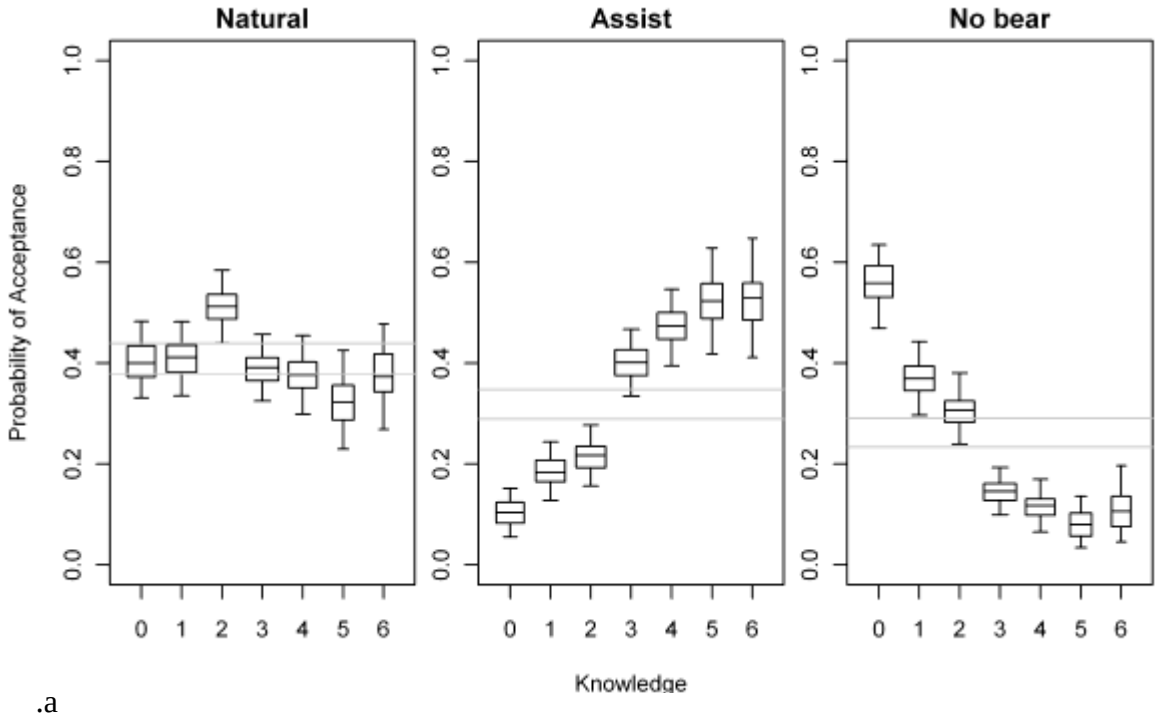
727 Figure 2.



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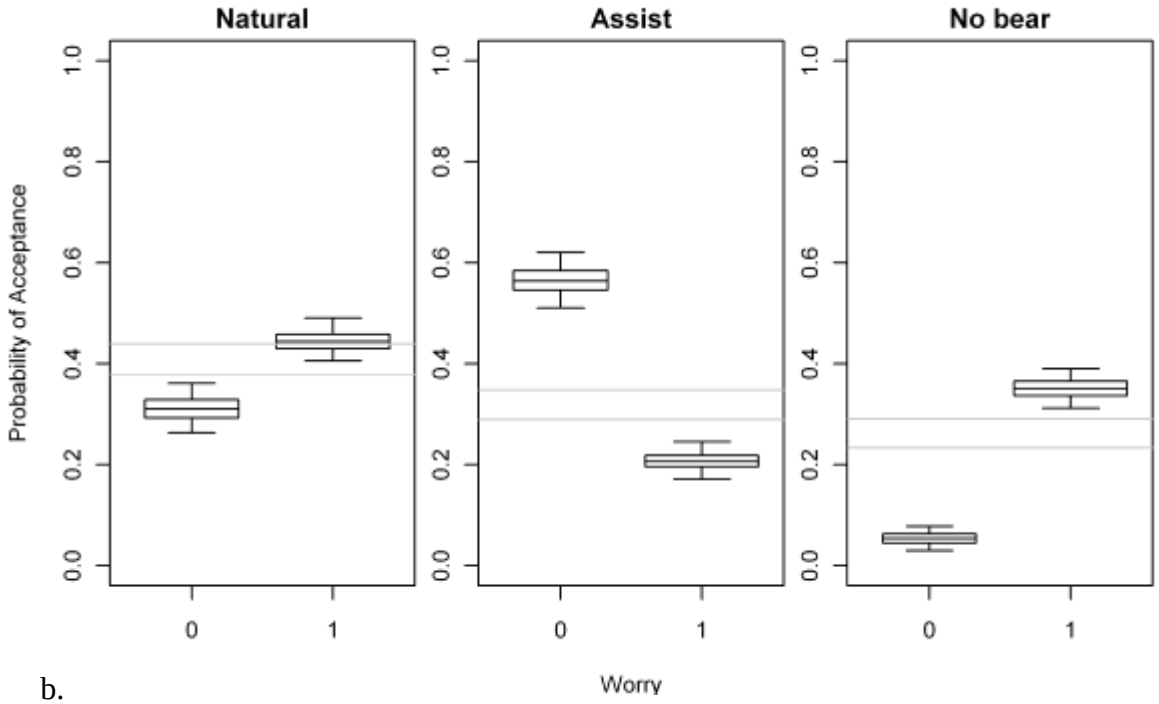

729 b.

Table 1. Responses to three potential black bear recovery strategies for East Texas (adapted from Morzillo and others 2007b).

Strategy	Support (%)	Unsure (%)	Non–support (%)
Natural (no human assistance)	38.4	31.4	30.2
Assist (human–assisted reintroduction)	32.1	31.7	36.2
No bear (bears should not exist)[a]	6.2	20.8	72.9

[a] Re–grouped from: strongly agree = 2.1%, agree = 4.1%, unsure = 20.8%, disagree = 41.1%, and strongly disagree = 31.8%. Strongly agree and agree were pooled as support; disagree and strongly disagree were pooled as non-support.

Table 2. Independent variables used and descriptive results[a] for analysis of conservation strategies for black bear in East Texas, USA (adapted from Morzillo and others 2007a).

Variable (*n*)	Categories and Coding for Multivariate Analysis	Descriptive results[a]
Community type (*985*)	Large city (>50,000 people) = 1	0%
	Small city (10,001 – 50,000 people) = 2	22.6%
	Suburb = 3	5.6%
	Large town (5,000 – 10,000 people) = 4	13.4%
	Small town (<5,000 people) = 5	20.4%
	Rural, farm = 6	12.4%
	Rural, non–farm = 7	25.6%
Number <18 (*979*)	Integer provided by respondent	Mean = 0.67; SD = 1.03
Pets (*985*)	Yes (1), or No (0)	Yes = 70.6%; No = 29.4%
Sex (*984*)	Female (1), or Male (0)	Male = 71.9%; Female = 28.1%
Age (*962*)	Respondent provided year of birth; difference between 2004 and that year	Mean = 54.0 years; SD = 15.11
Education (*977*)	Primary school (grade 8) = 1	3.1%

	High school or equivalent (e.g., GED) = 2	28.4%
	Vocational or trade school = 3	9.2%
	Some college = 4	25.8%
	Associate's or two year degree = 5	7.5%
	College graduate = 6	17.0%
	Graduate or professional degree = 7	9.0%
Income (*895*)	Less than $20,000 = 1	14.3%
	$20,000 to $39,999 = 2	24.7%
	$40,000 to $59,999 = 3	24.4%
	$60,000 to $74,999 = 4	14.9%
	$75,000 or more = 5	21.6%
Organization member (*981*)	Yes (1), or No (0)	Yes = 11.1%; No = 88.9%
Utilitarian activities (*905*)	Often (3), Sometimes (2), or Never (1); six activities total	Range = 1–18; Mean = 10.87; SD = 3.52
Passive–appreciative activities (*938*)	Often (3), Sometimes (2), or Never (1); three activities total	Range = 1–9; Mean = 7.02; SD = 1.64
Tenure (*974*)	Integer provided by respondent	Mean = 38.78 years; SD = 19.25

Livestock (*957*)	Yes (1), or No (0)	Yes = 14.4; No = 85.6
Acres owned (*974*)	Integer provided by respondent	Mean = 22.13 acres; SD = 84.14
Knowledge (*995*)	Yes (1) or No (0) for each question Sum = total knowledge; range=0–6	Mean = 2.48 correct; SD = 1.77
See bear (*987*)	Yes (1), or No (0)	Yes = 23.4%; No = 76.6%
Want (*991*)[b]	Yes (1), or No (0)	Yes = 64.4.%; or No = 19.0%
Worry (*991*)[b]	Yes (1), or No (0)	Yes = 49.5.%; or No = 33.9%

[a] Descriptive results were weighted to account for oversampling of rural residents.

[b] As noted in the text, *Want* and *Worry* are derived from responses to a single question. Those who responded that they "have no particular feelings about black bears" (16.7% of respondents) on this item are not included here.

Table 3a. Multinomial logistic regression analysis[a-b] for *Natural* recovery strategy support for black bears in east Texas; support for the strategy is the reference category.

Model	"No Support" versus "Support"			"Unsure" versus "Support"		
	β	Wald	Exp(β)	β	Wald	Exp(β)
Intercept	-6.643	18.451*		-0.093	0.005	
Community type	0.061	0.453	1.062	0.134	2.420	1.143
Number <18	0.489	9.260*	1.630	0.043	0.089	1.044
Pets[c]	-0.380	1.409	0.684	-0.047	0.024	0.954
Sex[c] (female=1)	-0.814	5.809*	0.443	-0.299	1.210	0.742
Age	0.022	2.601	1.022	-0.008	0.401	0.527
Education	0.037	0.206	1.038	0.066	0.761	1.068
Income	0.214	4.122*	1.239	0.027	0.076	1.027
Organization member[c]	0.259	0.394	1.296	0.410	0.970	1.507
Utilitarian activities	0.100	5.070*	1.106	-0.012	0.082	0.988
Passive-appreciative activities	0.289	7.249*	1.335	-0.002	0.001	0.998
Tenure	-0.007	0.379	0.993	-0.015	2.122	0.985
Livestock[c]	0.009	0.001	1.009	-0.074	0.056	0.929
Acres owned	-0.003	1.580	0.997	0.000	0.000	1.000
Knowledge	-0.032	0.160	0.968	-0.089	1.295	0.915
See bear[c]	0.293	0.931	1.340	0.059	0.036	1.061
Want[c]	0.281	0.581	1.324	0.158	0.284	1.171
Worry[c]	-0.912	11.544*	0.402	0.151	0.337	1.163

[a] All variable relationships $df = 1$; an (*) denotes significance at the 95% confidence level.

[b] Log-likelihood test (comparing the model to a null model with only an intercept): $X^2 = 114.932$, $df = 34$, $p \leq 0.001$.

[c] Although SPSS prints out coefficients for dummy variables (when treated as factors rather than covariates) that compare the "0" category to the "1" category, for ease of interpretation, we report the coefficient for comparing the "1" category to the "0" category (similar to using a dummy variable in linear regression).

Table 3b. Multinomial logistic regression analysis[a-b] for *Assist* recovery strategy support for black bears in east Texas; support for the strategy is the reference category.

Model	"No Support" versus "Support"			"Unsure" versus "Support"		
	β	Wald	Exp(β)	β	Wald	Exp(β)
Intercept	2.553	2.498		3.656	5.373*	
Community type	0.060	0.378	1.062	0.010	0.010	1.010
Number <18	-0.219	1.611	0.804	-0.313	3.649	0.731
Pets[c]	0.372	1.095	1.451	0.364	1.001	1.439
Sex[c] (female=1)	0.952	7.094*	2.591	0.885	6.196*	2.423
Age	0.009	0.423	1.009	-0.006	0.181	0.994
Education	0.072	0.671	1.075	0.136	2.391	1.145
Income	-0.103	0.829	0.902	0.002	0.000	1.002
Organization member[c]	-0.792	2.882	0.453	-0.163	0.153	0.850
Utilitarian activities	-0.059	1.517	0.943	-0.093	3.842	0.911
Passive-appreciative activities	-0.325	7.965*	0.723	-0.238	4.202*	0.788
Tenure	0.007	0.379	1.007	-0.016	1.619	0.984
Livestock[c]	-0.012	0.001	0.988	-0.144	0.161	0.866
Acres owned	0.001	0.078	1.001	0.002	0.421	1.002
Knowledge	-0.068	0.611	0.934	-0.186	4.545*	0.830
See bear[c]	-0.290	0.752	0.748	-0.579	2.893	0.560
Want[c]	-2.778	24.366*	0.062	-1.660	7.818*	0.190
Worry[c]	1.190	17.573*	3.287	0.844	8.891*	2.326

[a] All variable relationships $df = 1$; an (*) denotes significance at the 95% confidence level.

[b] Log-likelihood test (comparing the model to a null model with only an intercept): $X^2 = 202.909$, $df = 34$, $p \leq 0.001$.

[c] Although SPSS prints out coefficients for dummy variables (when treated as factors rather than covariates) that compare the "0" category to the "1" category, for ease of interpretation, we report the coefficient for comparing the "1" category to the "0" category (similar to using a dummy variable in linear regression).

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Table 3c. Multinomial logistic regression analysis[a-b] for *No bear* recovery strategy support for black bears in east Texas; "Strongly Disagree" is the reference category.

Model	"Disagree" versus "Strongly Disagree"			"Unsure" versus "Strongly Disagree"			"Strongly agree" and "Agree"[c] versus "Strongly Disagree"		
	β	Wald	Exp(β)	β	Wald	Exp(β)	β	Wald	Exp(β)
Intercept	-3.554	5.524*		-4.492	3.657		-5.758	2.407	
Community type	-0.189	3.899*	0.828	-0.137	0.802	0.872	0.112	0.201	1.118
Number <18	0.008	0.003	1.009	-0.173	0.452	0.841	-0.443	1.520	0.642
Pets[d]	-0.154	0.194	0.857	-0.428	0.673	0.652	0.209	0.082	1.232
Sex[c] (female = 1)	0.359	1.123	1.432	0.413	0.721	1.511	0.366	0.281	1.442
Age	0.055	14.467*	1.056	0.051	5.264*	1.052	0.015	0.237	1.015
Education	0.260	8.692*	1.297	-0.014	0.009	0.986	-0.078	0.136	0.925
Income	-0.103	1.436	0.878	-0.121	0.490	0.886	-0.249	0.884	0.779
Organization member[c]	-0.265	0.421	0.767	-0.727	0.831	0.483	0.374	0.071	1.454
Utilitarian activities	0.110	5.779*	1.117	0.086	1.216	1.090	0.197	2.671	1.218
Passive-appreciative activities	0.001	0.000	1.001	0.138	0.641	1.148	-0.137	0.311	0.872
Tenure	0.004	0.117	1.004	0.007	0.179	1.007	0.026	1.170	1.026
Livestock[c]	-0.389	1.278	0.678	0.062	0.014	1.064	-1.716	3.687	0.180
Acres owned	0.007	3.264	1.007	0.006	1.506	1.006	0.009	2.775	1.009

Knowledge	-0.217	5.995*	0.805	-0.578	16.092*	0.561	-0.821	12.891*	0.440
See bear[c]	-1.188	13.260*	0.305	-1.580	5.968*	0.206	-0.851	0.951	0.427
Want[c]	-3.219	9.371*	0.040	-5.338	23.656*	0.005	-8.642	32.669*	0.000
Worry[c]	1.609	34.793*	4.998	3.268	30.666*	26.259	3.275	12.610*	26.443

[a] All variable relationships $df = 1$; an (*) denotes significance at the 95% confidence level.

[b] Log-likelihood test (comparing the model to a null model with only an intercept): $X^2 = 379.457$, $df = 51$, $p \leq 0.001$

[c] Strongly agree and agree were combined because of a relatively small number of responses to each.

[d] Although SPSS prints out coefficients for dummy variables (when treated as factors rather than covariates) that compare the "0" category to the "1" category, for ease of interpretation, we report the coefficient for comparing the "1" category to the "0" category (similar to using a dummy variable in linear regression).

Table 4. Summary of CPA, where single pluses (+) indicate a non-significant upward trend; double plusses (+ +) indicate a significant upward trend; single minuses (-) indicate a non-significant downward trend; double minuses (- -) indicate a significant downward trend.

Variable	*Natural*	*Assist*	*No bear*
Community type			
Number < 18	-	+	
Pets			
Sex	+	- -	+
Age	+	-	+ +
Education			-
Income	-	+	- -
Organization member	-	+ +	-
Utilitarian activities	- -	+ +	- -
Passive-appreciative activities		+ +	- -
Tenure	+		+ +
Livestock	-	+	
Acres owned class			
Knowledge		+ +	- -
See bear		+ +	- -
Want	-	+ +	- -
Worry	+ +	- -	+ +