INTERIM PERFORMANCE REPORT

Federal Aid Grant No. F17AF00264 (W-187-R-1)

Human Dimensions and Social Carrying Capacity for Black Bears in Eastern Oklahoma

Oklahoma Department of Wildlife Conservation

Grant Period: July 1, 2017 – December 31, 2019

Report Period: July 1, 2017 – December 31, 2019

FINAL PERFORMANCE REPORT

State: Oklahoma **Grant Number:** F17AF00264 (W-187-R-1)

Grant Program: Wildlife Restoration Program

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I. OBJECTIVES:

1. To estimate the social carrying capacity of black bears (*Ursus americanus*) in 3 geographic/ demographic areas of eastern Oklahoma using mail surveys of residents. Results will inform the potential establishment and management of bear hunting seasons in these regions of Oklahoma

2. To assess awareness, values, attitudes, and behaviors of residents in 3 geographic/demographic areas of eastern Oklahoma residents toward black bears in areas with an established black bear population and a bear hunting season, areas with black bears but no bear hunting season, and areas with black bear habitat but few or no black bears. Results will inform black bear management and focus bear awareness outreach in demographically varied parts of eastern Oklahoma.

II. SUMMARY OF PROGRESS:

A. APPROACH

Study Area

We portioned eastern Oklahoma into three study regions that encompassed the state's two established black bear populations, in addition to northeastern Oklahoma. The northeastern study region was made up of Craig, Delaware, Mayes, Nowata, Ottawa, and Rogers counties. Human population desity in this region was 23.07 people/km^2 (United States Census Bureau, 2017 estimate). There is not an established black bear population in the northeastern study region, although there have been black bear sightings in this area. Many of these are thought to be transient young male black bears emigrating from Arkansas or from the east-central Oklahoma population. In the two years prior to the beginning of this study, there were at least 2 nuisance bear reports per year (Curt Allen, Oklahoma Department of Wildlife Conservation, unpublished data).

Adair, Cherokee, McIntosh, Muskogee, Sequoyah, and Wagoner counties comprised the east-central study region with a human population density of 27.04 people/km^2 (United States Census Bureau, 2017 population estimate). Black bear trapping for population estimation was conducted in the counties of Adair, Cherokee, and Sequoyah, which had a human population density of 21.65 people/km^2 (United States Census Bureau, 2017 population estimate) and a black bear density of about 0.019 bears/km^2 (unpublished data). The east-central study region contained a population of approximately 100 bears residing on the Ozark Plateau in Oklahoma (Lyda et al. 2016). Nuisance bear reports in

the east-central study region were at least 6 in 2015, 10 in 2016, and 14 in 2017 (C. Allen, ODWC, unpublished data).

The southeastern study region contained Atoka, Bryan, Choctaw, Haskell, Latimer, LeFlore, McCurtain, Pittsburg, and Pushmataha counties with a human population density of 9.02 people/km^2 (United States Census Bureau, 2017 population estimate). With about 1,300 black bears residing in a 9,367-km^2 study area in LeFlore, McCurtain, Latimer, and Pushmataha counties (Perez 2018), the black bear population was 0.14 bears/km^2 while the human population density for those 4 counties was 7.27 people/km^2 (United States Census Bureau, 2017 population estimate). Nuisance calls about black bears decreased over the three years prior to this study, with 30 nuisance calls in 2015, 22 in 2016, and 8 in 2017 (J. Ford, ODWC, unpublished data).

The arrangement of the three regions represented a north-to-south gradient of black bear presence to relative absence. The southeastern region was the only area in our study's scope that contained a black bear hunt, which at the time of this study was limited to four counties, LeFlore, McCurtain, Latimer, and Pushmataha.

Questionnaire

We used a mail-back questionnaire (Appendix A) to collect data from adult ($\geq$ 18 years) residents of eastern Oklahoma. We purchased a sample of 4,500 Oklahoma households from a private sampling company (Survey Sampling, Inc., Shelton, CT). The sample was stratified across the three study regions, with 1,388 households each sampled in the southeast and east-central regions, and 1,724 households sampled in the northeast study region. We oversampled the northeast study region by 5% because we felt that residents from this region were less likely to respond to the survey, due to their limited experience with black bears.

We used a modified version of Dillman's Tailored Design method to formulate our contacts with the sample (Dillman 2000). The first contact was made in August 2018 and was comprised of a packet containing the 12-page questionnaire, a participant information sheet, and a business reply envelope. Non-respondents from the first mailing were sent a reminder postcard, and then subsequently a second mailing of the survey packet. Non-respondents from the second mailing were sent a second reminder postcard. A subset (n=30) of final non-respondents were contacted by telephone for non-response bias analysis. Budget restrictions prevented us from administering a third mailing of the survey packet or conducting a mailed nonresponse bias survey. Oklahoma State University's Institutional Review Board (AG-18-29, May 2018) approved our survey materials and sampling protocol.

To address Objective 1, the survey asked respondents to assess the black bear population in their area with respect to impacts associated with particular black bear population sizes (Fig. 1). In addition to the situation that described the current perceived population, they were asked to choose the situation that described their preferred, fewest, and highest black bear population that they would accept. We conferred with ODWC biologists to determine that Situation 2 was representative of the

black bear density and human interactions typical of the northeastern study region, Situation 3 was representative of the east-central study region, and Situation 4 was representative of the southeastern study region. Situation 5 represented a black bear density and human interaction frequency that was consistent with a black bear population at biological carrying capacity.

Each hypothetical situation below describes the different impacts associated with certain black bear population sizes. Situation 1 represents no black bears, and situation 5 represents the largest black bear population size considered in this questionnaire. Please use these 5 situations to answer questions 7-10.

Situation 1	• No black bears
Situation 2	• Black bears in a **few** Eastern Oklahoma counties at **very low** numbers • No damage to personal property, crops, or livestock most years • Vehicle (including trains) collisions with black bears **extremely** rare
Situation 3	• Black bears in **many** Eastern Oklahoma counties but at **low** numbers • Black bears seen occasionally near rural homes or roads • Residents **rarely** experience personal property damage (ex: deer feeders, garbage cans, siding, etc.) • A small handful of bear-vehicle (including trains) collisions per year
Situation 4	• Black bears in **most** Eastern Oklahoma counties at **moderate** numbers. • Black bears often seen near rural homes or roads • Residents **occasionally** experience personal property damage (ex: deer feeders, garbage cans, siding, etc.) • Black bear-vehicle (including trains) collisions more frequent
Situation 5	• Black bears in **all** Eastern Oklahoma counties in the **highest** numbers their habitat can sustain • Frequent, widespread sightings near rural homes and roads • Occasional black bear sightings in towns • **Somewhat more** residents experience personal property damage (ex: deer feeders, garbage cans, siding, etc.) than in situation 4 • A small number of pets harassed or attacked by black bears each year • Regular black bear-vehicle (including trains) collisions

Figure 1. The scale with which survey respondents were asked to indicate their perceived current situation with respect to bear abundance and impacts in their area, and their preferred abundance/impact level, the fewest black bears they would accept and the highest they would accept. Each situation represents an increased level of human-black bear interaction.

To address Objective 2, additional questions collected information about respondents' awareness, values, attitudes, and behaviors with respect to black bears, wildlife in general, and perceptions of risk in relation to black bears (see Appendix A, B).

Statistical Analysis

Objective 1: We used Kruskall-Wallis tests to determine differences in respondents' preferred black bear population size and perceived current population size (based on Situations in Fig. 1) among the three study regions. We used Chi-Squared Tests of Independence to assess differences among categories within each region.

Objective 2: Responses for "preferred" black bear population size were used as the dependent variable for acceptance in an ordinal logistic regression analysis. This analysis evaluated the influence of the following independent variables on resident acceptance of black bears in their region: Current perception of black bear population

size, Attitudes toward black bears, Risk perceived in relation to black bears, Existence (value orientations with respect to wildlife in general), Rights of wildlife, Behaviors (are respondents willing to alter storage of garbage and bird feeders to avoid conflicts with black bears), and Support for lethal forms of bear management (such as hunting) (see full explanations of each variable and their derivation from questionnaire responses in Appendix B). Additional demographic variables included in the analysis were Indigenous (Native American or biracial with Native, or not Native), Age, Education, Gender, and Region.

NOTE: Further analysis of the same questionnaire data (at no additional cost) was conducted using structural equation modeling and spatial analysis of the psychological factors that determine human acceptance of black bears in eastern Oklahoma (see Appendix B). This analysis aimed to validate a previous psychological model of acceptance in a human population with varying levels of interactions with black bears (Zajac et al. 2012), and gain insight from spatial analysis to inform outreach in eastern Oklahoma. Because this was not part of the original proposal, it is not detailed in the Final Report, but is included as Chapter 3 in the accompanying thesis (Appendix B).

B. RESULTS

Questionnaire Respondents

Out of 4,500 questionnaires mailed, 28 were unable to be delivered due to incorrect addresses, six potential respondents declined to participate, and one person's questionnaire was returned because they were deceased. This led to an effective sample size of 4,465. A total of 697 usable questionnaires were returned, resulting in an adjusted response rate of 15.6%. Although the response rate is notably lower than similar studies (Caplenor et al. 2017, Riley and Decker 2000, Zajac et al. 2012), the responses exceeded the desired marginal error of 5% (Dillman et al. 2009). Demographics of respondents were comparable to the general population of Oklahoma except that men were slightly overrepresented (58.5% of sample; 49.5% of general population) and age of respondents was older than the general public because we only allowed adults to respond to the surveys. Nonresponse bias analysis revealed that non-respondent demographics did not differ significantly from respondent demographics. The most prominent reason for nonresponse was that potential participants did not remember receiving the survey.

Objective 1

There was no significant difference among the three study regions in the perceived current or the preferred black bear population sizes based on the five situations in Fig. 1. Respondents from the southeastern and east-central study regions appeared to underestimate the current black bear population in their areas (Fig. 2). However, the mean preferred black bear population size was greater in all three regions than their perception of the current population size, the fewest bears they would tolerate was similar to perceived current population size, and the highest number of black bears they would tolerate was much higher than the perceived current black bear population size.

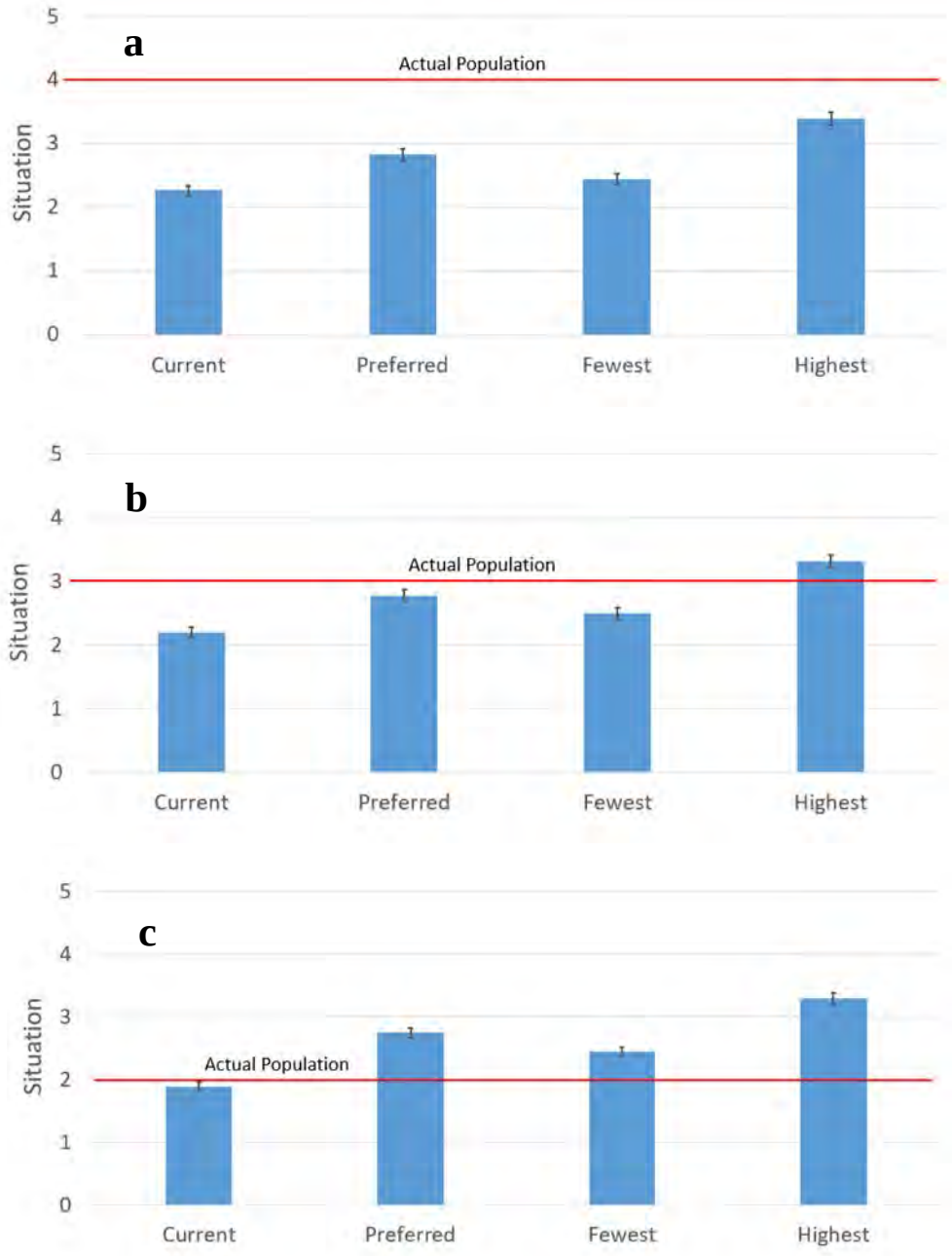

Fig. 2. Mean perceived current, preferred, fewest acceptable, and highest acceptable black bear abundance/impact level in a) southeast Oklahoma, b) east-central, and c) northeast Oklahoma based on survey responses (N=697 surveys). Situations based on descriptions of black bear numbers and impacts described in Figure 1. Red line indicates the situation that reflects the actual black bear population in the region, determined by ODWC and OSU black bear biologists.

Objective 2

Mean values of the independent variables be used in the generalized ordinal logistic regression model, averaged across respondents from all 3 eastern Oklahoma regions, suggested that the majority of respondents had positive attitudes toward bears (mean > 4 "neutral") and placed very high value on wildlife in Oklahoma in general (Table 1). Perceived risk from black bears was low (<4) and respondents were generally willing to undertake behaviors to reduce the possibility of black bear-human conflict.

Table 1. Summary of independent variables in the generalized ordinal logistic regression. HUNTED is a binary variable (0=No, 1=Yes). Education is on a scale of 1 (less than a high school diploma) to 7 (graduate/professional degree). Gender is a binary variable (0=Male, 1=Female). CURRENT is on a scale of 1 to 5. Cognitive variables are on a scale of 1 to 7. EXISTENCE is the value placed on the existence of Oklahoma wildlife, RIGHTS refers to belief in the rights of animals, and SUPPORT refers to level of support for controversial black bear management practices. Means represent pooled data from all three study regions in eastern Oklahoma.

Variable	*n*	Mean	S.D.
CURRENT	681	2.07	0.907
Cognitive variables			
ATTITUDES	668	5.03	1.245
EXISTENCE	685	6.41	0.916
RIGHTS	685	3.62	0.987
RISK	681	3.19	1.557
SUPPORT	666	4.58	1.390
BEHAVIOR	684	5.24	1.730
Demographic variables			
HUNTED	682	0.60	0.489
AGE	678	59.52	14.878
EDUCATION	679	4.15	1.831
GENDER	680	0.43	0.540

People who perceived a higher current black bear population in their area generally had higher acceptance of bears (Table 2). Similarly, people with positive attitudes toward black bears were more accepting of them. With respect to value orientation, respondents who valued the existence of wildlife in Oklahoma were more accepting of black bears ($P \leq 0.01$). The value orientation of wildlife rights had no significant influence on acceptance. Respondents that were willing to alter their birdfeeder and garbage storage behavior were more accepting of black bears ($P \leq 0.01$). We did not detect a difference in risk perception among the three study regions. However, overall risk perception was lower than expected, given the threats that black bears pose to people and their property. Support for controversial black bear management methods (hunting as a tool for management, allowing hunters to bait bears, and destroying problematic nuisance bears) had a marginally significant effect on acceptance ($P \leq 0.1$).

Table 3. Results from the ordinal logistic regression on data collected from a mail-back questionnaire, sent to residents of eastern Oklahoma concerning their awareness, attitudes, values, behaviors, and perceptions of risk in relation to black bears. The dependent variable was acceptance of black bears as indicated by the respondents' "preferred" relative population size.

Independent variables	Coefficients (Full Model)	Coefficients (Reduced model)	Odds ratios
CURRENT	0.636***	0.603	1.827
ATTITUDES	0.588***	0.585	1.795
EXISTENCE	0.537***	0.565	1.759
RIGHTS	0.031		
RISK	-0.317***	-0.314	0.730
SUPPORT	0.108*	0.090	1.094
BEHAVIOR	0.195***	0.193	1.213
AGE	-0.001		
EDUCATION	0.111**	0.126	1.135
GENDER	-0.850***	-0.805	0.447
NATIVE	0.106		
NORTHEAST	0.028		
EAST-CENTRAL	0.049		
Chi-Square	276.94***		
McFadden pseudo R^2	0.2077		
n	617		

***$p \leq 0.01$,** $p \leq 0.05$,,* $p \leq 0.10$,

Among socio-demographic variables, neither age nor indigenous racial identity had a significant effect on acceptance (Table 2). People with higher education levels were more tolerant of black bears ($P \leq 0.01$). Gender also had a significant impact on acceptance of black bears, with men being more tolerant of bears than women ($P \leq 0.01$). There was no effect of study region on acceptance.

C. DISCUSSION

Although respondents from the southeastern and east-central regions had a lower perception of the situation describing the current black bear population size and impacts than researchers and biologists, respondents' preferred black bear population size was larger, on average, than the perceived current population size in all three regions. The fewest black bears they would tolerate was similar to the current perceived population size in the southeastern and east-central study regions, and higher than the current perceived population in the northeastern region. Taken together, these results suggest social acceptance of current black bear populations with some social capacity (preferred population sizes) for black bear population growth. Acceptance capacity in the east-central study region was of specific interest in our study, as the public had expressed interest in hunting this population. Previous research addressing the demographics of the east-central population indicated that currently a hunt would detrimentally affect the black bear population due to the young age of these black bears and the fact that 2/3 of the population was male (Lyda et al. 2016). Our results reported here suggest that the residents of east-central Oklahoma are tolerant of the population of black bears that the region currently hosts, and that opening a hunt is not necessary to satisfy the public with respect to black bear control. As this black bear population becomes better established, and if densities bring about higher rates of black bear-human conflict, the population could both be better able to withstand new hunting opportunities and be effectively controlled with a hunt.

People with higher perceptions of the current black bear population, people with positive attitudes toward black bears, and men were more accepting of black bears. These results are consistent with findings about wildlife stakeholder acceptance capacity for courgars (*Puma concolor*) in Montana (Riley and Decker 2000). Based on odds ratios, perception of current black bear population had the greatest impact on tolerance. This may indicate that people who have lived near higher densities of black bears for longer periods of time were more habituated to them and thus more accepting. Positive attitudes toward black bears and the existence value of wildlife in Oklahoma in general is similar to findings of Fulton et al. (1996), who demonstrated that this value orientation was associated with positive attitudes toward hunting and fishing.

As hypothesized, risk perceptions had a negative effect on acceptance of black bears, though perceived risk from black bears in Oklahoma was lower than expected. The odds ratio suggests that a unit increase in perceived risk from black bears will likely decrease respondent tolerance by 27%, making this an important factor that can be influenced by outreach to educate people on behaviors that can decrease the likelihood of human-black bear conflict. One factor in the low perception of risk may be the fact that Oklahoma has yet to experience high-profile cases of human-black bear conflict

(attacks on humans or pets), with existing types of human-bear conflict currently limited to property damage (deer feeders, garbage cans, bee hives).

Somewhat surprising was the finding that, based on the odds ratio human females were 45% less tolerant of black bears than men, all else being equal. In other studies, the influence of gender was either not considered or is non-significant (Capelnor et al. 2017, Riley and Decker 2000, Zajac et al. 2012). In contrast, other studies have found that gender plays a defining role in the acceptability of wildlife management actions, with women being less supportive of lethal wildlife control methods (Dougherty et al. 2003, Zinn et al. 2000). Men are typically less risk-averse than women (Byrnes et al. 1999), which could perhaps explain why we observed women being less accepting of black bears.

Respondents with higher education levels, other covariates remaining constant, were more tolerant of black bears, as hypothesized. We expect this trend exists because more educated individuals tend to have less dominion-oriented and more naturalistic views, compared to the more utilitarian views of their peers (Bjerke et al. 1998). Previous research has documented this effect of education on acceptance for large carnivores (Bjerke et al. 1998, Kellert et al. 1996, Riley and Decker 2000).

Despite reasonable efforts, survey responses of this study were below the desired rate. Nonetheless, non-response bias analysis showed that the demographics of non-respondents did not differ significantly from respondents, and that the demographics of the study participants were similar to those of the human population in eastern Oklahoma. Given these factors, and the reason the majority of non-respondents did not participate because they did not remember receiving the questionnaire, our concern for nonresponse bias was reduced. Our measure for behavioral intentions only assessed two specific behaviors that humans could take to reduce their chances of conflicts with black bears – changing storage of garbage and changing how they store their bird feeders at night. In reality, there a many preventative behaviors that humans can take to reduce human-black bear conflict and including only two of these limits the scope of our scale. Lastly, while income is typically included in the demographic sections of mail surveys such as ours, we left this variable out because we felt that it might seem invasive and, given the survey's length, we were willing to sacrifice this item.

D. MANAGEMENT IMPLICATIONS

Risk perceptions and general attitudes were identified as having a significant influence on human acceptance of black bears in eastern Oklahoma. Both are cognitions that can be affected by outreach to positively influence human acceptance of black bears. Based on the effect of these two factors on acceptance, we recommend that agencies and extension professionals focus on reducing risk perception of black bears in eastern Oklahoma by disseminating resources that educate the public about ways to reduce human-black bear conflict. Simultaneously, encouraging positive attitudes toward black bears by educating stakeholders on their ecological benefits has potential to raise acceptance as well. Due to the strong effect of gender on acceptance, with women being less tolerant than men, we would suggest managers devise outreach that engages

women living in eastern Oklahoma in an attempt to lower risk perceptions and raise positive attitudes toward black bears.

Contrary to our hypothesis, there were no regional differences in perceptions of the current black bear population sizes, risk perceptions, attitudes, or acceptance among the three study regions. Bearing this in mind, we recommend that wildlife management agencies implement broader regional efforts to reduce risk perception and increase positive attitudes toward black bears within the demographics outlined above.

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F. ACKNOWLEDGEMENTS

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Appendix A – Thesis with Survey Instrument

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