Bear-Human Conflicts Research in Colorado – *Summary of Background and Objectives*

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BACKGROUND

Conflicts among people and black bears (*Ursus americanus*) are increasing nationwide, as the human population grows and urban development expands in and around black bear habitat. While state and federal wildlife agencies are responsible for minimizing bear-human conflicts, they are also responsible for maintaining viable bear populations. This balance is proving to be difficult, as wildlife agencies struggle to find effective management solutions while conflict rates continue to rise, particularly around urban areas. Whether increases in conflicts reflect recent changes in bear population trends or just behavioral shifts to anthropogenic food resources, is largely unknown, as bear population parameters have been exceeding difficult to estimate.

The primary cause of black bear-human conflicts along the urban-wildland interface has been attributed to the availability of anthropogenic food resources to bears. Urban areas contain a wealth of reliable, high-calorie food, in the form of garbage, fruit trees, vegetable gardens, pet food, and bird feeders. As opportunistic foragers, bears readily exploit these resources, resulting in negative interactions with people. These interactions, however, have been highly temporally and spatially variable, generating uncertainty about the relative influence of natural food availability, conflict management, harvest, and bear population trends on driving annual variation in rates of bear-human conflicts. Without a thorough understanding of the factors that exacerbate nuisance bear behavior, and uncertainty about the relationship between conflict rates and bear dynamics, it has been difficult for wildlife agencies to initiate effective management practices.

Bear use of the urban environment has serious consequences for people and bears. For people, bear-human conflicts lead to increased public safety concerns, property damage, and high management costs, while for bears they lead to increased mortality. For example, in 2007 Colorado data analysis unit (DAU) B-11 reported >500 public safety and property damage conflicts with bears, resulting in >$500,000 expended by the Colorado Division of Wildlife (CDOW) in bear management. This is one of 19 bear DAUs in Colorado, and encompasses the towns of Aspen and Vail, which have been hotspots of bear-human conflicts. That year, in B-11 alone, 44 bears were euthanized for conflict control, 25 were translocated for nuisance behavior, 27 died of road kill, and 30 were legally harvested. Overall, this resulted in >75% of bear mortality attributed to conflicts with people, with unknown consequences for local bear populations.

Given expected changes in both human development and climate patterns, bear-human conflicts should rise in the future. As the human population grows, development will continue to permeate bear habitat, creating additional opportunities for conflicts with bears. This situation will likely be exacerbated by anticipated changes in annual weather patterns. Drought conditions reduce the availability of natural foods for bears and are associated with an increase in bear-human conflicts. Drier, warmer weather, as predicted with climate change, is expected to escalate conflicts with bears in the coming years.

STATEMENT OF NEED

- ***Identify management strategies to reduce bear-human conflicts***

Ultimately, the public will not tolerate ever-increasing conflicts with bears and wildlife agencies must find effective solutions to resolve this pressing problem. Yet, despite the trajectory of increasing black bear-human conflicts, and the severe consequences of those conflicts for both people and bears,

best management practices for reducing conflicts remain unclear. Managers commonly employ education, aversive conditioning, and increased harvest to curb conflict rates, yet when the effectiveness of these strategies has been scientifically tested, they have been found to be largely ineffective as implemented. Investigators have suggested alternative approaches for reducing conflicts, such as reducing the availability of anthropogenic food for bears, using models to increase translocation success of nuisance bears, and altering public hunting programs to be spatially or temporally aligned to remove nuisance bears. These techniques may be useful for reducing conflicts, but their efficacy has not been tested.

Removing anthropogenic food - Given that bears are attracted to anthropogenic food it is believed that eliminating the availability of this resource will dramatically reduce nuisance bear behavior. This strategy has had some success within national parks, and anecdotally in some communities (Mammoth Lakes CA, Juneau AK, Whistler BC), but no research has ever rigorously tested the costs and benefits of "cleaning up" a town. Given the high price to operationally "bear-proof" a community, municipalities must have definitive evidence that such an effort would significantly decrease conflict activity before initiating major changes to waste storage and collection practices. A thorough, scientific evaluation of this approach would be greatly beneficial in identifying clear management strategies to reduce conflicts for wildlife agencies and municipalities.

Translocation Suitability Modeling - Translocation of nuisance black bears is another common management technique that has been applied with varied results. Often bear translocation decisions are handled by field managers without formal guidance. These professionals are knowledgeable on bear capture and transport techniques, but often lack the flexibility to release bears in other management areas without obtaining approvals from different managers, who are often also experiencing nuisance bear problems. Limitations in selecting a translocation site and the profound movement ability of bears can result in an unsuccessful translocation – where the bear continues to cause conflicts either in its new location or after returning to the capture site. To improve bear management, a strategic translocation approach is needed that applies the best available science on bear habitat quality, conflict potential, and harvest in the selection of bear release sites, while incorporating statewide collaboration among managers.

Targeted Public Hunting - Wildlife managers frequently increase harvest quotas to reduce bear-human conflicts, but the scientific literature has been equivocal on the effectiveness of this approach. Lack of harvest success has been largely attributed to a mismatch between the timing and location of bear-human conflicts and the timing and location of the hunt, as bear-human conflicts peak during summer months along the urban interface while public hunting occurs during the fall in areas away from development. As a result, a general increase in harvest likely translates into a reduction in the population at large, not necessarily the removal of nuisance bears. This strategy also inherently assumes that conflict rates reflect bear population sizes, an untested assumption that could potentially lead to overexploitation. To determine whether public harvest can successfully curb conflict rates, hunts need to be spatially and/or temporally coordinated with conflicts as they occur. This is a strategy that has the potential to reduce management-related conflict mortality and increase recreational hunting opportunities, but has yet to be thoroughly evaluated.

- ***Elucidate the dynamics of bear populations along the wildland-urban interface***

To sustainably manage bear populations in the face of a growing human population and changing landscape conditions, it is critical to elucidate the dynamics and drivers of bear populations. Of those factors that influence bear dynamics, the contribution of urban environments is the least understood, most contentious, and has the greatest potential to elicit major population change. While urban environments offer bears the benefit of anthropogenic food, they also inflict the cost of increased

mortality from lethal removals, translocations, and other urban factors (i.e. road kills), yielding uncertainty about whether urban environments contribute to the growth or decline of local bear populations. In the two studies that have evaluated bear populations along the wildland-urban interface, bears experienced reduced survival with population-level consequences. In Florida, Hostetler et al. (2009) found that reduced adult survival caused the "urban" bear population to decrease in size, while the adjacent "wild" population increased, demonstrating the possibility of source-sink dynamics. Meanwhile, in Nevada, Beckmann and Berger (2003) found that bears around urban development were present at higher densities and had greater reproductive rates, but cubs had exceedingly low survival. The researchers suggested that urban areas operated as an ecological "trap" as human food attracted bears into town only to lead to their demise and depopulate the adjacent wildlands. Conversely, many management agencies have assumed that increasing bear-human conflicts reflect increasing bear populations, and that the availability of anthropogenic foods has actually bolstered bear populations. So, do urban areas serve as population sources, sinks, or ecological traps for bears?

This question is complicated by the influence of annual variation in natural foods, or environmental stochasticity, on bear behavior and demography. Preliminary data collected in Aspen, Colorado suggests that bears increase time spent in urban environments in years of natural food failure and decrease that use when natural foods are readily abundant. This pattern implies that bears avoid urban environments when conditions allow, despite the common assumption that a bear savvy to anthropogenic foods will consistently be a "conflict bear." In a state like Colorado, where human development has effectively permeated almost all tracks of prime bear habitat, such seasonal or annual shifts in behavior have key implications for management. For example, if a small subset of bears consistently causes a majority of the conflicts with people, then the removal of a few key individuals should alleviate the problem. If, however, high rates of conflict coincide with years of natural food failure because a large proportion of the population is seeking alternative food resources, such a removal strategy may be ineffective. Currently, managers have no information about the proportion of bears that cause conflicts, how the use of urban resources varies among individuals, and how variation in the availability of natural foods drives temporal variation in urban resource-use.

Questions about the effects of urban environments on bear demography have key implications for bear management, as agencies struggle to define conflict management practices and set harvest quotas with minimal information on population trajectories. Currently, conflict bear management practices (lethal removal and translocations) are based on several inherent assumptions such that 1) there is a correlation between bear-human conflicts and bear population size, 2) conflicts are caused by a few individual bears and their removal will alleviate local problems, and 3) management removals do not significantly influence regional bear dynamics or local harvest opportunities. The validity of these assumptions have yet to be determined, despite their importance for bear management. To develop sustainable management practices for black bears, we must tease apart the relative influences of annual variation in natural bear foods, the availability of anthropogenic foods, conflict-management (lethal removals and translocations) and harvest on bear dynamics and bear-human conflicts.

- ***Develop better tools to monitor the dynamics and drivers of bear populations***

Despite the need to understand the drivers and trends of bear populations to direct management, Garshelis and Hristienko (2006) found that most states have limited data from which to make sound decisions. As a result, state agencies rely on coarse harvest indices that yield little power for detecting population change, and no ability to distill the underlying causes of change. New tools that increase the scientific rigor in monitoring bear populations are desperately needed, so that harvest quotas are biologically-based and designed to meet population objectives.

Recent advances in wildlife statistics have focused on maximizing the use of traditional age/sex-at-harvest data, that which is routinely collected during mandatory harvest reporting. New techniques are available to more effectively extract information about population trend from harvest data and can be augmented with mark-recapture or telemetry data to increase precision in parameter estimation. While these approaches hold tremendous promise for supporting biologically-based bear monitoring and management, they are still in their infancy and have yet to be widely implemented. These techniques could be used to identify the value of different data types for tracking populations and to allocate field efforts that most efficiently determine bear population trends across a region of interest. Such information could also be used to inform annual harvest recommendations, elucidate statewide bear dynamics, and reconcile the relationship between bear population trends and conflict rates.

OBJECTIVES

1) Test management strategies to reduce bear-human conflicts. Bear-human conflicts in urban areas of Colorado echo nationwide trends, as they are increasing in number, frequency, and severity, and have become a high priority management issue in all regions of the state. In evaluating strategies to reduce conflicts we will:

1A) Experimentally reduce the availability of anthropogenic food to bears in an urban environment to assess the effect on bear-human conflicts and bear behavior (DURANGO).

1B) Develop and evaluate a strategic statewide plan for the translocation of nuisance black bears (STATEWIDE).

1C) Assess a spatially-targeted harvest program designed to reduce the number of nuisance bears (STATEWIDE).

2) Determine the influence of urban environments on regional bear population dynamics. According to the U.S. Census Bureau, Colorado is the third fastest growing state, with a population that has tripled in size in the last 50 years. Despite widespread human development throughout the state, there is substantial uncertainty about the effects of urban habitats on bear habitat selection and population dynamics. To elucidate the effects of urban environments on bears we will:

2A) Evaluate the role of annual variation in natural foods on bear movement and resource-use (DURANGO).

2B) Estimate vital rates of urban and wildland bears relative to their use of natural and anthropogenic food resources (DURANGO).

2C) Quantify the effects of resource-use, conflict bear management (lethal removals and translocations) and harvest on bear demography (DURANGO).

3) Develop population and habitat models to support the sustainable management of black bears in Colorado. Bear populations have been notoriously difficult to monitor for state wildlife agencies. While meeting other project objectives we will obtain key biological data on bears from which we can:

3A) Use multiple data sources (harvest, DNA mark-recapture, and telemetry data) to develop improved bear population models to guide annual harvest regulations and inform statewide estimates of population size and trend (STATEWIDE).

3B) Build regional habitat models to better predict bear density, direct the location of future monitoring efforts, and identify key seasonal resource areas (STATEWIDE).

EXPECTED RESULTS AND BENEFITS

This will be one of the most comprehensive studies to date on bear-human conflicts and the ecology of urban and wildland bears, resulting in crucial information that will be used to manage black bears in Colorado and across the country. Results from this study will:

- Quantify the relative effectiveness of different management strategies (anthropogenic food removal, translocations, and spatially-targeted harvest) for reducing bear-human conflicts, information which will be broadly used by wildlife managers. A reduction in bear-human conflicts will ultimately increase public safety, reduce property damage, decrease wildlife management costs, and gain management credibility for collaborating agencies.

- Identify key differences in the demographic and behavioral patterns of urban and wildland bears to better inform managers about the efficacy of conflict-bear management (lethal removals and translocations) on population dynamics. For example, this study will elucidate the proportion of bears using urban food resources, how that proportion varies due to natural food conditions, the relationship between population performance and conflict rates, and whether "town" serves as a source, sink, or ecological trap.

- Provide robust, data-driven population and habitat models to guide the monitoring and management of bears in Colorado. These models will be used to inform annual harvest regulations, revise statewide estimates of population size and trend, and direct the location of future data collection efforts. Such information will increase the scientific rigor that is applied to the management of bears in Colorado and ensure that management actions to minimize conflicts are consistent with population objectives.

- Advance theory and statistical methodology for linking resource-use patterns of animals to their demographic rates, and ultimately, population growth. To date, habitat and demographic analyses have been largely conducted independently of one another, with a relationship that is often inferred rather than directly measured. Using intensive field population data and GPS collar locations, this study will explicitly link space-use, resource acquisition, and demographic patterns, exploring new conceptual and statistical avenues to elucidate their relationships.