

COYOTE MANAGEMENT IN RESIDENTIAL AREAS: HUMAN DIMENSIONS RESEARCH NEEDS

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Abstract: To effectively meet the challenges of urban coyote (*Canis latrans*) management, wildlife professionals will need human dimensions (and ecological) research to fill information gaps associated with a typical program planning process. Most wildlife agencies use the steps of a rational decision-making approach to plan and develop their programs (i.e., they define goals, identify problems and opportunities, identify management objectives, develop management action alternatives, and implement and evaluate alternatives). We describe general human dimensions (HD) information needs associated with each step, and then suggest corresponding HD research priorities to support urban coyote management decisions. We suggest that HD research priorities include: (1) situational analysis to characterize impact perceptions, attitudes, experiences, and behaviors of key stakeholders in hot spots for human-coyote conflict; (2) investigations that shed light on the processes of coyotes' habituation to humans and humans' habituation to coyotes; (3) studies that allow managers to apply acceptance capacity concepts to objective setting; (4) locally-specific research to characterize acceptability of various management actions among key stakeholders; and (5) outcome evaluations to measure attitude, perception, and behavior change associated with management actions.

Key words: *Canis latrans*, coyote, human dimensions, rational decision making, research agenda, urban

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INTRODUCTION

Human-coyote conflicts in urban areas are no longer restricted to western cities. For simplicity, urban will be used to denote areas that exhibit either urban or suburban development characteristics. Coyotes (*Canis latrans*) have successfully colonized at least portions of nearly every metropolitan area in the eastern United States, and human-coyote conflict is emerging as a management issue for wildlife agencies across North America. Public

expectations for management attention are growing in a number of eastern states (e.g., New York, Massachusetts, Rhode Island), yet wildlife professionals lack a comprehensive information base to support coyote management decisions in urban settings. Some studies have focused on the ecological dimensions of human-coyote conflicts in urban areas, but research devoted to understanding the human dimensions of urban human-coyote conflicts is limited. Human dimensions (HD) of

wildlife management include "how people value wildlife, how they want wildlife to be managed, and how they affect or are affected by wildlife management decisions (Decker et al. 2001). HD research is an applied field that draws upon multiple disciplines to: 1) increase theoretical understanding of social or psychological constructs (e.g., norms, attitudes); 2) apply empirical findings or insights to management practice; or 3) evaluate and refine methods for stakeholder engagement in management decisions or processes (Decker et al. 2004).

The purpose of this paper is to outline human dimensions research needs in the context of urban coyote management. Our foundational premise is that wildlife professionals will need human dimensions (and ecological) research to fill information gaps associated with a typical program planning process.

Most federal and state natural resource management agencies use the steps in a rational decision-making approach to plan and develop their programs (e.g., Culhane and Friesema 1979, Crowe 1983, NYSDEC 2003). That is to say, when developing management programs, they typically make an effort to define program goals, identify problems and opportunities, identify management objectives, develop management action alternatives, and implement and evaluate management alternatives. Completing all the steps in a rational decision-making model allows managers to better address three overarching management questions. In the context of urban coyote management, those questions could be:

Why should we develop an urban coyote management program (what are our goals; what broad policies and specific objectives do we need to achieve those goals)?

How should we achieve our urban coyote management objectives (what suite of management actions should we implement)? Are we on the right course (does our current suite of management actions address the right objectives; are current management actions effectively moving us toward our goals)?

HD inquiry can fill some of the information gaps associated with each step in a rational decision-making process. In the following sections, we describe general HD information needs associated with each step. We then suggest specific research priorities for each step in the context of urban coyote management decisions (Table 1). Our general recommendations derive from previous review articles, which articulate how HD research can be used to inform program decisions (Decker et al. 1992, 1996, 2001, 2004, Krueger et al. 1987, Manfredi et al. 1996, Riley et al. 2003, Vaske et al. 1995, Vaske et al. 2001). Our specific recommendations are informed by our current application of those ideas to urban coyote research in New York, as well as review of published HD literature.

Readers should note that the separation between steps is an artificial device we use only for discussion purposes. Some of the research priorities we discuss are useful for informing more than one step in the process, and the sequence of inquiry associated with a multi-faceted research program is not always linear as implied in Table 1.

Table 1. A matrix of human dimensions information needs to support a rational decision-making model for urban/suburban coyote management.

Steps in decision-making	General information need	Related information needs for urban/suburban coyote management
Defining goals (Fundamental objectives)	<ul style="list-style-type: none"> ▪ Baseline data on public values toward wildlife and how values are changing. ▪ Baseline data on stakeholder-defined impacts. 	<ul style="list-style-type: none"> ▪ Clarify impact perceptions among stakeholders in hot spots for human-coyote interaction. ▪ Identify value orientation subgroups in urban, suburban, and exurban areas.
Identify problems and opportunities	<ul style="list-style-type: none"> ▪ Clear understanding of issue at hand. ▪ General understanding of overall problem system. ▪ Knowledge of extent and severity of existing problems. ▪ Understanding of bases for conflict between people and wildlife or people vis-à-vis wildlife. ▪ Knowledge of opportunities to achieve management goals. 	<ul style="list-style-type: none"> ▪ Identify stakeholder characteristics, motivations, experiences with, and attitudes about coyotes. ▪ Identify extent and nature of human-coyote and pet-coyote interactions. ▪ Increase understanding of possible human-coyote co-habitation.
Identify objectives and standards	<ul style="list-style-type: none"> ▪ Clarification and critique of management objectives (i.e., formative evaluation of program objectives based on understanding of problem system). ▪ Define acceptable limits (normative standards) for a given situation. 	<ul style="list-style-type: none"> ▪ Normative standards for acceptable coyote behavior. ▪ Factors affecting tolerance of coyotes. ▪ Impact dependency, WSAC. ▪ Coyote-related risk perception.
Develop management action alternatives	<ul style="list-style-type: none"> ▪ Baseline data on public acceptance of management alternatives. ▪ Forecast anticipated outcomes from management actions (i.e., secondary or collateral effects). 	<ul style="list-style-type: none"> ▪ Assess stakeholders' management preferences. ▪ Norms research on lethal control.
Implement and evaluate alternatives	<ul style="list-style-type: none"> ▪ Quantitative feedback on outcomes of management actions. 	<ul style="list-style-type: none"> ▪ Efficacy of programs to promote problem prevention behavior by key groups (e.g., pet owners) ▪ Efficacy of removing problem coyotes as a means to reduce negative psychological impacts.

STEP 1: DEFINING GOALS

Wildlife management goals and broad policies establish why management is undertaken—they reflect the fundamental

objectives for management (Riley et al. 2003). Like the underlying values they reflect, the broad goals of a wildlife agency are few in number and enduring (broad

goals such as protecting public safety, maintaining self-sustaining wildlife communities, and relief from wildlife damage) can be applied in any coyote management context.

Two categories of HD information form the foundation for setting broad goals and policies. First, wildlife managers need baseline data on "how different segments of the public value and evaluate wildlife and associated interactions" (Decker et al. 2004). Insights about basic belief patterns among key stakeholder groups, defined by Fulton et al. (1996) as value orientations, can help wildlife managers understand what people expect from a wildlife management program, how people are likely to engage with wildlife, and what kinds of management actions they are likely to tolerate or reject (Decker et al. 2004).

Second, wildlife managers need baseline information on the effects of human-wildlife interactions that various stakeholders consider worthy of management attention. Effects assigned this level of significance by stakeholders are referred to as impacts (Riley et al. 2002). The fundamental objectives of wildlife management, when articulated, nearly always focus on managing stakeholder-defined impacts (Riley et al. 2003). Managers are aided in clarifying appropriate fundamental objectives in terms of impacts when they possess current information on how people are affected by wildlife and how much importance stakeholders place on those various effects.

In our view, the highest priority research need with respect to goal definition is obtaining information that can be used to clarify impact perceptions among specific sets of stakeholders in hot spots for human-coyote interactions. Managers need better location-specific information about the importance that residents place on experienced, and perceived, effects

associated with coyotes. Priority information includes: perceptions about risks coyotes pose to pets or people, perceived effects of coyotes on other urban wildlife, and benefits people associate with the presence of urban coyotes.

Recent work in New York provides an example. Managers have identified northern Westchester County (part of the New York City metropolitan area) as a hot spot for complaints about interactions with coyotes. The New York State Department of Environmental Conservation (NYSDEC) and Cornell University initiated a scoping study in 2006 to gather preliminary information on impact perceptions, attitudes towards coyotes, and interactions with coyotes in northern Westchester County. Face-to-face interviews with key informants and a telephone survey of residents in two study areas was coupled with a telemetry study of coyote movements and habitat use to understand better the causes, extent, nature, and impacts of human-coyote interactions. Stakeholder surveys will be needed to assess impact perceptions among residents in other urban areas where human-coyote conflicts are emerging. Plans are underway to collect information from residents in another geographic region of New York in 2007.

STEP 2: IDENTIFYING PROBLEMS AND OPPORTUNITIES

Managers often have little research to support a clear definition of the human dimensions of problems they face. Given that the reason for coyote management is usually to address problems, a solid information base for problem definition is essential. Problem definition includes assessing and describing the extent and severity of existing and potential problems, as well as determining the basis for possible human-wildlife or human-human conflicts (Manfredo et al. 1996). Developing

effective solutions for wildlife management problems requires wildlife researchers and managers "to view problems from a variety of perspectives, including the scientific, social, political, and the economic, and appreciate how others (e.g., policy scientists, politicians, economists) view the problem" (Kroll 2007). Viewing problems from different perspectives is aided by HD inquiry.

Because the urban coyote situation is a relatively new management context for many state wildlife agencies, wildlife managers could benefit from HD research that provides a thorough situational analysis in specific geographic areas. Situational analysis should identify key attitudes, perceptions, experiences, and behaviors of stakeholders. HD investigators should document the extent and nature of human-coyote and pet-coyote interactions occurring in residential areas. Situational analysis also should include efforts to assess human behaviors that create food attractants for coyotes, because researchers have suggested that food conditioning plays a role in aggressive coyote behavior toward humans (Bounds and Shaw 1994, Harris et al. 1997, Howell 1982, Timm et al. 2004).

Managers will be able to craft better problem definitions if they have research data on human-coyote co-habituation. Typically, habituation in wildlife refers to an animal's lack of behavioral fear response to the presence of humans after repeated, non-consequential encounters (McNay 2002). Wildlife habituation to humans is recognized as a growing management challenge because it may lead to negative human-wildlife interactions (Geist 2007). Some researchers have noted that if coyotes are not harassed by humans and deterred from human-inhabited landscapes, they may habituate to the presence of people (Kitchen et al. 2000, Timm et al. 2004).

While this idea of coyote-human co-habituation is theoretical, it is grounded in empirically based research and warrants further exploration within the context of human-coyote interactions in urban spaces. A better understanding of co-habituation would aid managers in targeting specific human or coyote behaviors that could lead to problematic encounters. Investigators need to examine human behaviors toward coyotes before, during, and after encounters to understand how human behavior may influence coyote habituation and the outcome of interactions.

STEP 3: IDENTIFYING MANAGEMENT OBJECTIVES

Managers need to develop criteria they can use to set objectives and evaluate agency progress toward achievement of objectives. Tolerance threshold concepts (Zinn and Miller 2003), such as wildlife acceptance capacity (Decker and Purdy 1988) or wildlife stakeholder acceptance capacity (Carpenter et al. 2000), can be useful to managers in this regard. Miller (2007) points out that "Concepts like 'social carrying capacity and 'wildlife acceptance capacity' have been critical in the formulation of regulations and in the revision of operational (wildlife damage) control programs." Applying these concepts in specific contexts, like urban coyote management in a particular metropolitan area, requires that managers have some sense of how acceptance capacity differs across key stakeholder groups.

To utilize acceptance capacity concepts when setting urban coyote management objectives, managers need stakeholder-specific data on: norms about acceptable coyote behavior in urban areas; factors affecting acceptance capacity (e.g., risk perception, coyote-related experiences); and the relation between various impacts from coyotes and tolerance levels. Our

current investigation in New York includes efforts to examine coyote-related risk perceptions and norms about acceptable coyote behavior via a combination of interviews and surveys.

One more information need related to objective setting warrants mention here, though it is primarily a planning rather than a research activity. We want to point out the value of identifying management objectives as a result of exercises to link ends and means. Creating ends-means diagrams can help managers craft objectives and identify information gaps that should be addressed by additional research.

We offer Figure 1 as an example of an ends-means diagram. The authors developed Figure 1 with a team of state wildlife managers who provide oversight on our coyote research project. It demonstrates how the managers involved believe a set of interconnected objectives and means (management actions) will achieve one of their desired ends for urban coyote management (i.e., their goal of maintaining coyotes as a socially acceptable wildlife resource rather than a pest species in urban areas).

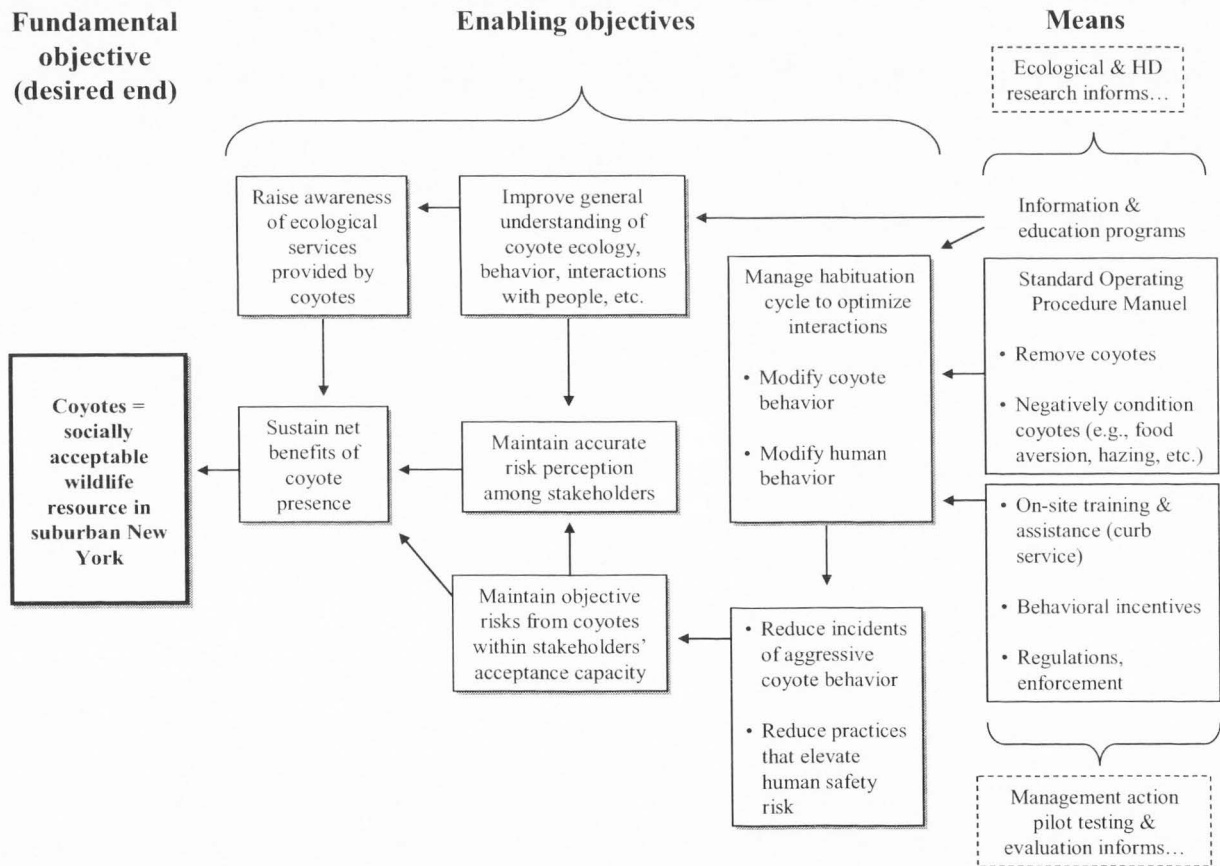


Figure 1. A diagram constructed by a team of wildlife managers and human dimensions researchers to articulate ends-means connections for achievement of one fundamental objective (end) for urban-coyote management in New York State.

Managers created the figure working from left to right. After establishing their goal, the management team crafted a set of objectives that they believed would enable them to reach their goal. The arrows in Figure 1 show managers' assumptions about the connections between goals and objectives. For example, these managers believed they could maintain coyotes as a valued resource if they sustain net benefits associated with urban coyotes. They will achieve that by reducing negative impacts and making stakeholders aware of positive impacts from coyotes. Managers will reduce negative impacts by reducing actual and perceived threats from coyotes. Having established linkages between objectives, managers could then clearly describe how and why the management actions (Figure 1, far right) can help them achieve their objectives.

Members of the research team can use Figure 1 to ensure the ecological and human dimensions work they are doing supports managers' key information needs. For example, Figure 1 makes it clear that managers believe that reducing actual threats to human safety will depend on the success of actions to change human and coyote behavior. Thus, creating this diagram clarified coyote-human co-habitation as an information gap that calls for new HD research.

STEP 4: DEVELOPING ACTION ALTERNATIVES

At this point in a decision-making process, potential action alternatives are evaluated with regard to their efficacy (i.e., their anticipated ability to achieve enabling objectives) and their potential to create undesired side effects for particular stakeholder groups, wildlife populations, or the natural environment. HD research is needed for two general purposes at the alternatives selection stage in decision

making: (1) to examine public acceptance of management alternatives (Decker et al. 2006); and (2) to identify the possible range of effects associated with a given management alternative (Manfredo et al. 1996).

Stakeholder disagreements about the acceptability of various coyote management actions make coyote management decisions contentious and controversial (Martinez-Espirnei 2006). Research that helps managers understand community norms about coyote management actions, especially lethal control actions, would help managers work through these controversies. Wittmann et al. (1998) provide some evidence for the common assumption that social norms about lethal management actions vary by species. They found that destroying a coyote was more acceptable than destroying a beaver in three of four contexts presented. They also found that destroying a problem coyote was more acceptable to respondents than destroying a mountain lion under similar circumstances (Wittmann et al. 1998). Their work provides a good example of the kind of norms research that would be useful in the context of urban coyote management.

Martinez-Espirnei (2006) investigated attitudes toward lethal control of coyotes and factors associated with acceptance of lethal control on Prince Edward Island, Canada. The population he studied was predominantly rural (he reports that 54% of the population there make a living from agriculture or fishing). However, his work demonstrates the type of research design needed to better understand the factors that explain variance in acceptance of coyote management alternatives.

STEP 5: IMPLEMENTING AND EVALUATING ALTERNATIVES

Evaluation measures the response of the management environment to actions implemented by the wildlife agency. Response by coyotes, people, or other aspects of the environment should be assessed to gauge achievement of objectives. Evaluation provides managers with the quantitative feedback on whether they are approaching or departing from management goals.

Resource limitations preclude wildlife agencies from completing in-depth evaluation of all program actions. Suitable levels of evaluative feedback can be achieved through routine monitoring on established program actions. However, agencies should plan ahead for integrated and thorough evaluation of new actions in an urban coyote management program.

Managers typically need to implement a combination of techniques to effectively resolve wildlife conflicts (Conover 2001). Managers will undoubtedly need to take a range of actions to address various coyote-related impacts in urban areas. We anticipate that evaluative feedback on problem prevention education and removal of individual coyotes will become priorities for HD research (because both actions are likely to be implemented by management agencies). Gore and Knuth (2006) provide an example of the kind of evaluation that will be necessary to gauge effectiveness of programs to encourage problem prevention behaviors (which typically depend on individual behavior change to reduce human-wildlife conflict). Gore et al. (2006) offer a set of indicators that could be used to evaluate the effectiveness of education programs to reduce conflicts with black bears. The same indicators might be used to evaluate education programs related to urban coyotes. Managers will need information on change

in impacts perceived by stakeholders to assess effectiveness of selective coyote removal as a management action.

SUMMARY AND CONCLUSIONS

Management and research experience suggest that the challenges of urban coyote management will be best met if wildlife managers' efforts are supported by an integrated ecological and sociological information base that can inform decision making. This paper offers guidance on using HD research to enhance the information base managers use to implement a rational planning process for wildlife management decisions. We have outlined a comprehensive set of HD research needs that can be applied to the context of urban coyote management. Among those needs, we believe the highest priorities include research that will improve understanding of: 1) which coyote-related effects stakeholders regard as impacts, and thus should be the focus of management attention in urban areas; 2) the process and relatedness of human and coyote habituation in urban areas; 3) acceptance capacity for coyotes among different stakeholder groups in urban landscapes; 4) acceptability of proposed management actions.

Wildlife agencies are likely to implement a suite of management actions in an effort to limit negative human-coyote interactions in urban areas. We urge wildlife professionals to plan ahead for comprehensive evaluation of new management techniques to assess changes in human attitudes, perceptions, and behaviors associated with those management interventions. Furthermore, we urge wildlife professionals to make study results available in management literature, so that we may collectively create the information base needed for improved urban coyote management. Journals such as *Journal of Wildlife Management* (The Wildlife

Society), *Human Dimensions of Wildlife* (Taylor & Francis Publishers) and *Human-Wildlife Conflicts* (Jack Berryman Institute) provide venues through which to build a literature base. We also encourage wildlife damage management professionals to convene additional symposium or other opportunities for researchers across North America to interact and share information on this topic of increasing importance.

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