

Expanding Problem Frames to Understand Human-wildlife Conflicts in Urban-proximate Parks

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EXECUTIVE SUMMARY: Landscape change that accompanies urbanization is leading to increased frequency and intensity of human-wildlife interactions. Many urban-proximate National Park Service (NPS) units are experiencing encroachment from development. This context presents increasingly complex wildlife management challenges for parks and recreation administrators and managers. White-tailed deer (*Odocoileus virginianus*) have been a major concern for over two decades in urban-proximate NPS units in the northeastern U.S., where biological studies have documented deer density, movement, and impact on park resources. Typically, NPS managers frame deer issues as population-management problems. The extent to which vegetation damage by deer affects the integrity of the unit's resource protection goals and objectives determines whether deer population levels in parks are acceptable or unacceptable, and to what extent. Deer that use urban-proximate parks also use habitats in surrounding communities and cause impacts to local community residents. Little research has assessed the scope of resident stakeholder understanding of the deer-management system for urban-proximate parks administered by the NPS. This study utilized semi-structured interviews with residents of communities near two parks to describe the potential breadth of complex deer issues and contributing factors (i.e., the management system). At both study sites, interviewees revealed the management system as a multi-level system of factors that contributed to perceived deer problems: (I) anthropogenic activities were seen to result in (II) broad ecological effects, causing (III) events or interactions between deer and people or resources, some of which lead to (IV) habituation of deer to anthropogenic activities, amplifying (V) perception of specific impacts experienced by stakeholders. A conceptual model was developed to visually depict the perceived rela-

tionship between the different system components. The NPS management frame and the dominant discourses at each park then were mapped onto the conceptual model to illustrate how differences in framing can contribute to suburban wildlife controversies. At both parks, the dominant discourse differed from the NPS management frame, illustrating that suburban deer issues are more than just complex; they are “messy.” Messy problems, while fundamentally complex, do not have a single problem formulation. Conceptual models like the one described in this study may be used as a starting point for future discourse-based stakeholder engagement processes to facilitate mutual learning between stakeholders and managers that expands perspectives beyond conventional problem frames to create sustainable solutions.

KEYWORDS: messy problem, suburban wildlife, problem framing

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Approximately 80 percent of Americans are urban-suburban dwellers (DeStefano, Deblinger, & Miller, 2005) and low density development continues to grow faster than any other type of residential sector (Crump, 2003). Some wildlife species are able to adapt to and utilize these human-altered landscapes, leading to increased frequency and intensity of human-wildlife interactions in urbanizing areas (DeStefano & DeGraaf, 2003; Glennon & Kretser, 2005; Patterson, Montag, & Williams, 2003). Many parks and recreation areas are experiencing encroachment from development, essentially becoming islands of wildlife habitat surrounded by lands managed for different purposes (Sellars, 1997). This context presents increasingly complex wildlife management challenges for parks and recreation administrators and managers.

The National Park Service (NPS) administers a wide variety of units, many of which are embedded in urban or urbanizing settings. White-tailed deer (*Odocoileus virginianus*) have been a major concern in urban-proximate NPS units in the northeastern U.S. for over two decades. Several parks¹ have undertaken biological studies to determine deer density, movement, and impact on park resources (for example, Frost, Storm, Batcheller, & Lovallo, 1997; Lovallo & Tzilkowski, 2003; Porter & Underwood, 1999; Shafer-Nolan, 1997; Underwood, 2005; Warren, 1991). Despite this wealth of biological information, management of suburban deer issues continues to generate controversy among stakeholders near urban-proximate parks, challenging park managers to consider new approaches. The NPS currently is developing five Deer Management Environmental Impact Statements (EIS) in parks across the northeastern U.S., all of which require opportunities for public input into management decisions under the National Environmental Policy Act of 1969 (NEPA, 42 U.S.C. § 4321 *et seq.*). In addition, many more parks are collecting data related to deer impacts and are poised for planning action (Leong & Decker, 2005). Consequently, white-tailed deer issues are useful to examine complex suburban wildlife management issues at urban-proximate parks. This study examined the breadth of meanings local community residents associate with deer issues to understand potential root causes of wildlife controversies on the urban-rural interface.

Problem Framing

The idea of framing has been used in the fields of communication and dispute resolution to help practitioners understand different perspectives of parties in conflict. Frames act as lenses or filters through which people interpret and process information (Lewicki, Gray, & Elliott, 2003). Frames both call attention to certain elements of an issue and direct attention away from other elements (Entman, 1993). In addition, assumptions about the way management problems are conceptualized, or framed, can impede resolution and contribute to the intractability of conflicts (Lauber, Knuth, & Deshler, 2002; Lewicki et al., 2003).

¹ The NPS administers many different types of units, one of which is National Park. However, for convenience, the terms "national park" and "park" will be used throughout this paper to refer to any unit administered by the NPS, regardless of official designation.

Deer issues in urban-proximate NPS units typically are framed as population-management problems. This problem frame was articulated by Coffey and Johnston (1997) as “ . . . whether deer population levels are acceptable or unacceptable, and to what extent vegetation losses to deer are affecting the integrity of the area’s resources or impacting management goals and objectives” (p.433). This perspective is supported in recent interviews with NPS managers (Leong & Decker, 2005) as well as the Deer Management EIS’s currently in progress. When the problem is framed in this manner, solutions typically focus on actions within park boundaries to protect vegetation or manage deer in the park. While NPS managers know that external factors influence deer population dynamics within the park, they have no authority to act on them directly; jurisdiction is limited to actions within park boundaries, except in a few situations related to fire management under the Wyden Amendment (16 U.S.C. § 1011 [a]).

Deer that use urban-proximate parks also use habitat in surrounding communities and may cause impacts to local community residents. Numerous studies have documented stakeholder beliefs and attitudes about deer and deer management in suburban communities (Curtis & Gavin, 1987; Lauber, Anthony, & Knuth, 2001; Stout, Knuth, & Curtis, 1997; West & Parkhurst, 2002). Fewer studies have assessed the components of deer issues salient to residents of communities near parks. Communities near a number of parks have expressed varying desires for deer management within the parks, demonstrating the relevance of park actions to local communities (Leong & Decker, 2005). One potential source of controversy surrounding deer issues in parks may be the difference in the way that NPS and stakeholders frame the problem.

Under NEPA, the federal government must provide opportunities for public input when any management action is considered that may significantly affect the environment or may be controversial (42 U.S.C. § 4321 *et seq.*). Deer management involves such actions. In the course of developing a deer-management plan, NPS managers are required to provide opportunities for public input. There is general agreement that the standard public hearing format is inadequate (Chess & Purcell, 1999), and recent NPS policies encourage dialogue-based public participation (National Park Service, 2007a). Pearce and Littlejohn (1997) suggest that this type of dialogue can assist stakeholders who hold incompatible problem frames to learn to see the problem from each other’s perspective. NPS natural resource managers desire guidance in implementing dialogue-based public participation and suggest that social science studies to better understand stakeholders would help parks prepare for scoping related to NEPA (Leong & Decker, 2005).

While the conventional NPS deer-management frame is documented for urban-proximate parks, how neighboring resident stakeholders understand the deer-management system has received less attention. Conceptual models that describe a management system from stakeholders’ perspectives have been shown to aid in debate and improve: (a) communication; (b) processing capacity; (c) technical, conceptual and social learning, and; (d) commitment to a decision (Stave, 2002; Vennix, 1999). The purpose of this study was to identify the breadth of factors that local community residents consider when conceptualizing deer issues in and

around northeastern urban-proximate parks. Portrayed schematically as a conceptual model, analysis of residents' views can illustrate for managers the complex array of factors that stakeholders consider in assessing deer issues and expectations for management. In addition, the conceptual model may be useful to facilitate mutual learning between stakeholders in future participatory processes, a fundamental step towards creating sustainable solutions.

Methods

Description of study sites

Two parks and associated communities with decades of dialogue on deer issues were chosen for study: Fire Island National Seashore (FINS) in New York and Valley Forge National Historical Park (VFNHP) in Pennsylvania. Fire Island is a barrier island 51.5-km long that runs along the southern coast of Long Island. Established in 1964, FINS is 7832 hectares (ha), encompassing approximately 42 kilometers (km) of Fire Island (including 17 communities), 24 smaller islands, and the William Floyd Estate on Long Island, home of one of the signers of the Declaration of Independence. Since the 1980s, local community members, biologists, and park staff have voiced concerns over the growing population of white-tailed deer. A number of projects have addressed these concerns, including: a study assessing deer health, an ongoing immunocontraception research project, and an interdisciplinary outreach project to discourage deer feeding and decrease human-deer conflicts. Local community members have been involved with these efforts, most of which garnered local and even national media attention.

VFNHP is a 1,300 ha park located 29 km northwest of Philadelphia. It was the site of the 1777-78 winter encampment of the Continental Army under General George Washington and was designated a national historical park on July 4, 1976. The first study of deer in the park was conducted in 1983. It indicated a relatively small deer population (165-185 animals) and no impacts to vegetation (National Park Service, 2006a). Negative impacts from deer herbivory were first officially noted in the early 1990s (K. Heister, NPS VFNHP, personal communication). Long-term monitoring of deer abundance and impacts to vegetation within VFNHP are ongoing, as are the public's concerns about associated impacts and a desire by some for VFNHP to manage deer. In June 2000, Congress directed NPS to initiate cultural and natural resource studies, in the context of deer impacts on the cultural landscape. In 2006, VFNHP initiated a White-tailed Deer Management Plan/EIS.

Data collection

To become familiar with the physical setting and better understand the perspectives of community residents, the senior author resided in Ocean Beach and in Sayville, New York, from August 21 to September 11, 2005, and in Valley Forge, Pennsylvania, from October 6-23, and November 11-12, 2005. A qualitative, interview-based approach was used to develop in-depth understanding of factors contributing to deer issues. The intent was to better understand how residents were inter-

preting their experiences with deer. Two types of interviews were conducted with individuals or small groups: (a) in-depth semi-structured interviews with known stakeholders and influential community residents (22 for FINS and 20 for VFNHP) and (b) short interviews with residents intercepted in local gathering places (65 for FINS and 42 for VFNHP). Community leaders, local homeowners, and longtime residents from all communities adjacent to the parks were purposefully targeted (not randomly selected) as subjects. The data reported below were part of a larger study to elicit local community residents' personal understandings of deer issues and deer management in parks, the role of parks in deer and other wildlife management, and the influence of public input in wildlife management in parks. Findings reported herein are based on responses to the following open-ended questions:

1. Please describe your observations on deer and deer management at the park and in the surrounding community.
2. Do you believe deer impact the park, either positively or negatively? How?
3. Do you believe deer from the park impact the local community, either positively or negatively? How?
 - a. How responsive is the park to these local concerns about deer?
 - b. How do you feel about the park's responsiveness to these concerns?

Follow-up questions and probes were used as necessary to elaborate on interviewee responses and to clarify intended meaning. Interviewees also were asked for any additional comments not covered by the prepared questions. Thus, potential components of the management system were not specified *a priori* in the interview guide but were introduced by interviewees and then discussed in detail. Interviews were conducted in English, with the exception of four interviews that were conducted in Spanish using a translator from FINS.

For interviews with influential stakeholders, subjects were identified through snowball sampling (Babbie, 2003). This method helped identify community leaders and individuals with a known stake in deer issues to be included in the study. First, NPS natural resource managers identified individuals with whom the park had regular contact related to deer or other natural resource issues. Interviews were conducted with these individuals, who were then asked to identify other influential local residents as potential subjects, whether or not those individuals typically interacted with the NPS. The sample reached saturation when the same individuals were named repeatedly. While individual, face-to-face interviews were preferred by researchers, group interviews and telephone interviews sometimes were preferred by subjects. To encourage candid discussions, interviews were conducted in the environment most comfortable to interviewees. Thus, subjects were interviewed individually or in groups at a day, time and location of their choosing. Interviews lasted from 30 to 165 minutes; the majority (64 percent) were audio recorded with sufficient audio quality for later transcription by one of three transcriptionists. All transcriptions were checked for accuracy by the interviewer. Some interviewees preferred not to be audio recorded; in other cases, environmental conditions (e.g., wind, music, other background noise) precluded effective recording. Handwritten notes were taken during the interviews and detailed field notes were prepared from them

as soon as possible following the interview (usually within one day). For interviews that were not audio-recorded, care was taken to capture in the notes the specific language used by interviewees.

Interviews with other local residents occurred at informal gathering places in the area (e.g., recreation sites, community events, cafes and quick-service restaurants, retail sites). Convenience sampling was used to identify potential interviewees. Local residents encountered at these locations were approached to participate in face-to-face interviews, which typically lasted 15-20 minutes. Only eight of these interviews were audio recorded due to background noise. Handwritten notes were taken during the interviews and detailed field notes were prepared as soon as possible following the interview (usually within one day).

Data analysis

Interview transcripts and notes were coded for themes using ATLAS.ti (version 5.0, Scientific Software Development GmbH, Berlin). An iterative process was used to generate codes based on emergent themes. That is, segments of text in the first interview were assigned thematic codes as they were identified. Each of these codes was then applied to text from the second interview. If the second interview introduced new themes, they were then added to the coding scheme. When new themes were added, previous interviews were re-scored to assure that codes were applied uniformly. Quotes were sorted to reveal key concepts and to capture relationships between themes. Coding and analysis were conducted by one researcher, with the intent that the findings from this study will be validated in future discussions between managers and stakeholders. The qualitative nature of these findings does not permit inferences about the proportions of members of the community who hold particular views.

Analysis of the management context at each park revealed similarities and differences between sites and types of interviewees (for individual park reports, see Leong & Decker, 2007a, 2007b). This paper utilizes interviews at both parks to identify the potential range of factors that stakeholders believe contribute to deer issues in and around urban-proximate parks. A schematic conceptual model was developed to illustrate the prominent factors, relationships between them, and problem frames, as identified by interviewees.

Results

Description of the management system

At both study sites, interviewees revealed the management system as a multi-level system of factors that contributed to perceived deer problems: (I) anthropogenic activities were seen to result in (II) broad ecological effects, causing (III) events or interactions between deer and people or resources, some of which lead to (IV) habituation of deer to anthropogenic activities, amplifying (V) perception of specific impacts experienced by stakeholders (Figure 1).

The majority of interviewees mentioned *only* anthropogenic activities as fundamental system drivers (i.e., inputs that affect all other elements of the system, either

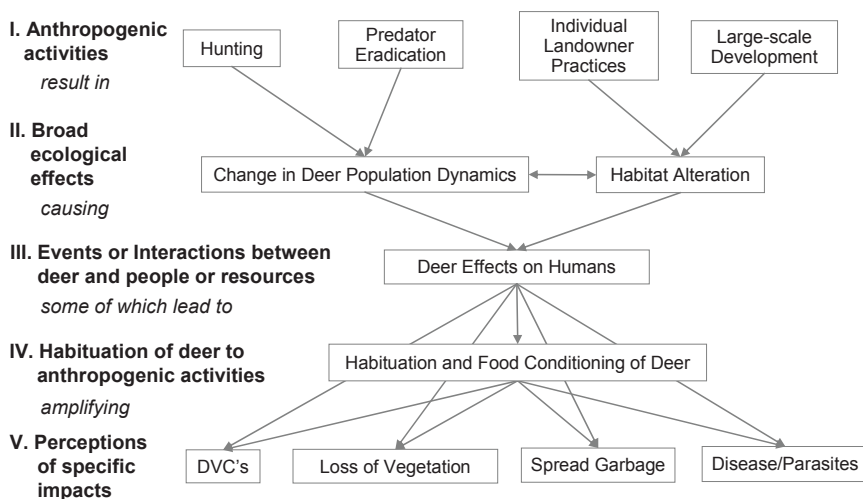


Figure 1. Elements of messy deer problems in and around northeastern U.S. NPS units, as collectively described by local community residents. DVC's is an abbreviation for deer-vehicle collisions.

directly or indirectly). Dominant factors included: various aspects of hunting (e.g., hunter motivations, state wildlife agency regulations, numbers of hunters, effectiveness of hunters), a history of predator eradication, collective effects of individual landowner practices (e.g., ornamental landscaping, fencing), and large-scale development (Figure 1: I). Few interviewees mentioned natural processes, such as harsh winters, which biologists believe may play the greatest role in determining deer population size (H. B. Underwood, State University of New York College of Environmental Science and Forestry, Syracuse, New York, personal communication).

Primary anthropogenic activities were described as having broad ecological effects (Figure 1: II). For example, changes in hunting pressure and predator eradication were believed to result in changes in deer population dynamics, notably increased population size. In addition, large-scale development and individual landowner practices outside the parks were believed to collectively alter available deer habitat, by both destroying natural habitat and creating artificial habitat that attracted deer into local communities.

Changes in deer population dynamics and habitat structure were perceived to result in interactions between deer and people or the resources that people valued (Figure 1: III). Some of these interactions involved additional anthropogenic activities, such as habituation and food conditioning² (Figure 1: IV). Habituation and

² Habituation is defined as a reduction of response to a repeated, inconsequential stimulus, usually resulting in loss of fear response to people, whereas food conditioning occurs when an animal learns to associate food with the presence of people due to positive experiences of acquiring food easily (McCullough, 1982; McNay, 1998).

food conditioning were seen to bring people and deer in close contact on a regular basis, thereby amplifying human-deer interactions.

Human-deer interactions can have important positive or negative impacts for the people involved (Riley et al., 2002). The majority of interviewees enjoyed viewing deer, which many described normatively: "... deer are a beautiful animal and everybody loves to view wildlife like that." Yet many also were concerned about negative impacts. Interviewees were concerned with four main classes of negative impacts: deer-vehicle collisions (DVCs), loss of vegetation (native, ornamental plantings, and vegetable gardens), deer getting into garbage, and diseases and/or parasites carried by deer (Figure 1: V).

Each component of the system described above can be affected by a number of management actions. The suite of potential actions that influence a single element of the system can be thought of as a family of solutions (Figure 2).

For example, interviewees concerned about the lack of hunting pressure on the deer population talked about different means to control populations directly; e.g., culling, altering hunting regulations such as bag limits or season length, or opening parks to special hunts. Other interviewees focused on different levels or on different components of the system, either with respect to problem elements or potential management actions. Thus, the families of solutions that interviewees considered to be reasonable were influenced by the set of system components they used to define the problem. Interviewees often discussed potential solutions in more detail than

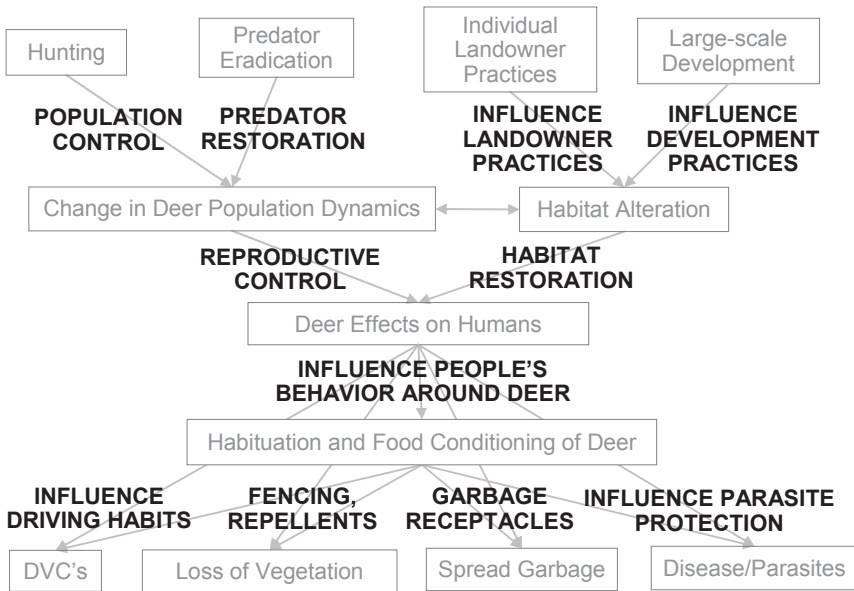


Figure 2. Families of solutions for each pathway in the system.

problem elements, seemingly based on the assumption that everyone defined the problem in the same way.

Problem Framing

Figures 1 and 2 outline the potential breadth of deer issues in urban-proximate parks. Such schematics can be used to illustrate similarities and differences in the way that different groups define a complex issue. For example, Figure 3 identifies the elements of the previously described NPS management frame within the stakeholder described system.

Recall that in this scenario, vegetation damage was used as the indicator of deer overabundance. In many parks, the geographic scope of deer impacts is widespread, making fencing and repellents ineffective or impractical as means to reduce impacts to vegetation. Instead, population management is the dominant area of focus. There are two families of potential solutions that address population size, one centered on different forms of lethal population reduction (population control such as hunting,³ culling), the other on forms of non-lethal population reduction

³ Hunting is prohibited by the enabling legislation of most urban-proximate parks. A park's enabling legislation can only be changed by Congress. NPS cannot lobby Congress to change the enabling legislation.

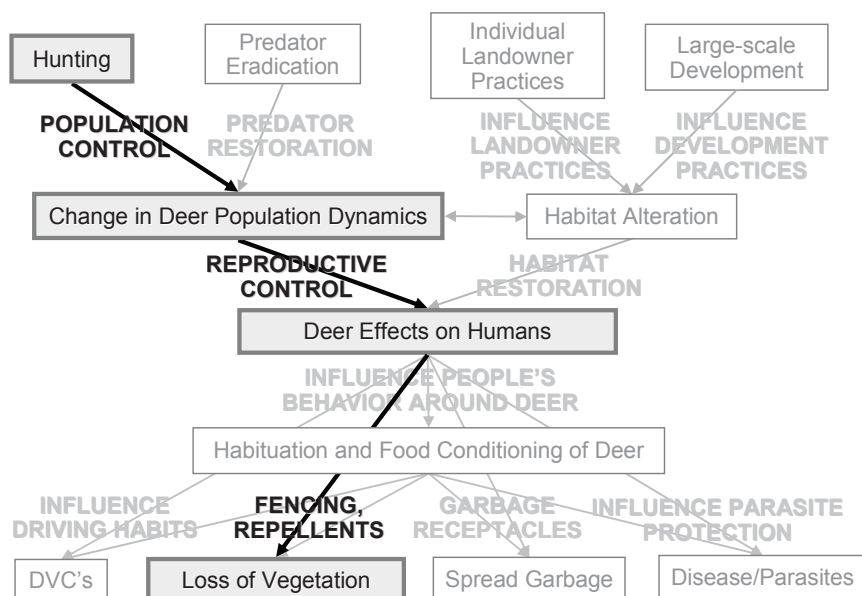


Figure 3. The conventional NPS natural resource management problem frame for deer issues in and around parks in the Northeastern U.S.

(reproductive control such as sterilization, contraception), effectively constraining the problem to a win-lose structure: hunters vs. animal rights vs. parks.

For interviewees, the relative salience of a component appeared to be influenced by the degree to which their expectations about that component matched their perceptions of the current condition of that component. Elements that were perceived to fall short of expected conditions became salient and therefore the focus of the problem. At FINS, the dominant discourse identified habituation and food conditioning (Figure 1: IV) as indicators of overabundance and centered on a debate over whether or not immunocontraception could effectively reduce deer populations (for full report, see Leong & Decker, 2007a). Interviewees were concerned about many different types of impacts, notably damage to gardens and ornamental plantings and the potential for Lyme disease transmission from ticks carried by deer (unlike NPS managers, very few mentioned concern about vegetation on FINS-administered lands). However, these impacts generally were described as tolerable up to the point at which deer became habituated or food conditioned. As one interviewee described, “I would say you cross the line when the white flag⁴ is no longer showing, when they are so familiar with people and that they are so unafraid of people and no longer wildlife. They are pests.” Habituation and food conditioning are adaptive from a behavioral ecology standpoint (Thompson & Henderson, 1998), yet these behaviors did not meet interviewees’ expectations for deer in their communities: “I have a problem with deer walking through the community’s garbage cans. It takes nature away from being a wild animal. They will walk right up to you looking for food.” And, “They’ve lost the instinct to run away. They’re de-deerified, humanized.”

A few interviewees reframed the problem to be about reducing the incidence of people feeding deer. However, most discussed methods to reduce deer abundance and focused attention on the ongoing immunocontraception research project. This type of solution is designed to affect population numbers, not food conditioning. In addition, bait stations were used to attract deer and facilitate administration of the immunocontraceptive. For many interviewees concerned about food conditioning, this form of population management was believed to exacerbate the problem. The project was made salient by its high visibility and ongoing controversy; bait stations were located throughout the communities, regular op/ed pieces appeared in local newspapers, and influential community members volunteered with the project. Interviewees had mixed beliefs about the effectiveness of this project. Some considered it successful because they believed the population was decreasing gradually, even though there was variation from year to year. Others believed it was not successful for precisely the same reason—the population was not decreasing consistently or quickly enough to reduce the impacts of concern. In other words, interviewees primarily concerned about specific impacts (Figure 1: V) often desired faster results from a management action, whereas interviewees concerned with higher levels of the system (Figure 1: II) were more tolerant of a longer time scale for reduction of specific impacts.

⁴ The white flag refers to the white tail raised as a signal of alarm, usually when a deer is in flight.

At VFNHP, one dominant discourse framed the problem as regional overabundance of deer. Many interviewees assumed the problem was whether VFNHP should allow a public archery season, a commonly applied management action in many city and state parks, townships, and even neighborhoods near VFNHP (for full report, see Leong & Decker, 2007b). Most of these interviewees described regional deer populations as the source of local problems and referred to different specific impacts (Figure 1: V) as evidence of overabundant populations (i.e., not simply perceived number of deer). This resulted in diverse ideas about whether or not the population of deer needed to be reduced and appropriate means to do so. Many respondents were less concerned about impacts from deer than about impacts from potential forms of population management (i.e., collateral impacts, generated by the management actions themselves [Decker et al., 2006]). In this situation, controversies over collateral impacts from potential management actions (e.g., hunting, use of agency sharpshooters) can overshadow the desired end result—reduction of primary impacts. For the most part, beliefs about the success of different management alternatives were based on whether deer numbers were affected, not whether adverse deer impacts were affected.

Notably, a second set of interviewees emphasized broad ecological effects (Figure 1: II) and framed the deer issues as a symptom of a development problem. They believed that unless the fundamental source of the problem was addressed (in this case, development), it was pointless to try to control the deer population. One interviewee summarized: “Living here, I’m seeing that the park is not the problem... there’s so much building, the deer used to be there, but now they’ve found a sanctuary in the park. Now they’re making their way into our neighborhood.” Many of these interviewees were involved in efforts to curb development in the region and offered habitat restoration outside the park as a potential solution. By broadening the problem frame beyond park boundaries, these interviewees identified activities that could complement efforts of the park, collectively reaching more components of the entire system and improving sustainability of management actions.

Discussion

This study describes the potential complexity of the suburban deer system, illustrated as a conceptual model. The model is one representation of the collective factors considered by local community residents when conceptualizing deer issues in and around northeastern urban-proximate parks. Our sampling methodology and the semi-structured nature of the interviews impose inherent limitations to the model serving as a full representation of reality. Validation of the model can be pursued through discussions between managers and stakeholders, which can offer important opportunities for mutual learning.

Even as a simplified depiction of reality, the model reveals several key characteristics of deer issues in urban-proximate parks. First, any component or combination of components can be considered part of the problem if a stakeholder’s (including a park manager’s) expectations for that component are not met. Second, opportunities exist for multiple types of management interventions at each level of the system depicted in the model. The traits of the interventions chosen depend on the

components of the problem they are designed to address (i.e., the way the problem is framed determines the families of solutions that are considered). In addition, there are both direct and indirect means to affect most components of the system. For example, speed enforcement is along a direct pathway to reduce deer-vehicle collisions because it acts at the specific impact level. On the other hand, deer-population control is an indirect pathway to reduce deer-vehicle collisions because there are a number of intervening levels between the action and the desired result. Management actions undertaken on indirect pathways should be evaluated carefully to assure they actually affect the fundamental component of concern and to identify collateral impacts of those actions.

The conceptual models in Figures 1 and 2 also are simplified in that only major pathways between system elements were identified. Feedback can be expected within the system (for example, deer-vehicle collisions affect population dynamics) and factors at one level may affect multiple levels (for example, hunting affects wildlife behavior as well as population). While it can be argued that a similar model could have been developed by managers or biologists, it is noteworthy that the breadth of considerations collectively identified by interviewees was broader than the problem frame typically considered by NPS managers. This finding does not imply that NPS managers do not recognize the influence of these broader elements of the system, but they are less prominent in planning efforts directed toward deer population management within park boundaries (the dominant NPS problem frame), for the policy and jurisdictional reasons mentioned earlier. Interviewees were aware of the problem components that are the focus of NPS management attention and also had more far-reaching concerns (which, if addressed, might influence the system more fully).

When dominant problem frames revealed by interviews of residents near two parks were compared to the NPS managers' frame, potential for controversy became apparent. Deer overabundance was a common interview theme. However, the conditions that defined overabundance were perceived differently by managers and interviewees. At both FINS and VFNHP, vegetation damage is the dominant indicator of overabundant local deer populations used by park managers (National Park Service, 2006b, 2007b). Residents interviewed at FINS, however, described changes in deer behavior that signaled a local deer problem. Interviewees at VFNHP spoke of regional deer populations and used a wider variety of specific impacts to evaluate overabundance. At both parks, the system level targeted by the dominant solution frame was not necessarily consistent with the level of the core perceived problem. Management actions that are designed to affect population dynamics will only indirectly affect specific impacts, and may affect different types of specific impacts at different rates. Thus, even if managers and stakeholders can agree to reduce number of deer and agree on means, disagreement on ends could lead to conflict if not explicitly defined *a priori*.

If stakeholders and managers do not recognize that their interests lie in different parts of the management system, they may apply different metrics of success to the same management action, resulting in incompatible opinions about whether or not a management action "works," thereby posing the risk of decreasing agency

credibility, eroding relationships, and ultimately increasing conflict. On the other hand, a more robust view of the problem may be achieved by synthesizing multiple problem frames and stakeholder perspectives. Future research should examine the utility of conceptual models that reflect multiple perspectives about the management system as a communication tool to facilitate this type of learning. If stakeholders and managers recognize discrepancies in their underlying interests, they may be able to find creative solutions. For example, in a cooperative management alternative (Coffey & Johnston, 1997), stakeholders with jurisdiction over different parts of the management system (e.g., development outside the park) would act in concert to collectively affect multiple pathways. Jurisdiction even may be at the individual private landowner level.

The conceptual model presented here illustrates the complexity of suburban deer issues, yet the existence of multiple problem frames indicates that suburban deer issues are more than just complex, they are “wicked” or “messy” (Allen & Gould Jr., 1986; Lachapelle, McCool, & Patterson, 2003; Ludwig, 2000; Patterson & Williams, 1998). Complex, or technical, problems are comprised of many inter-related components whose relationships are hard to identify and understand but are governed by predictable natural laws. In addition, a complex problem is defined by all stakeholders in approximately the same way. Thus, traditional analytical models of science can be applied and allow managers a high degree of confidence in predicting outcomes of interventions. Messy problems, while fundamentally complex, do not have a single “correct” formulation of the problem. Rather, “The definition [of the problem] is in the mind of the beholder, and how that person chooses to explain the problem determines the scope of the search for a resolution” (Allen & Gould Jr., 1986, p. 22). As noted by Rittel and Webber (1973), the process of problem framing often *is* the problem.

Historical studies reveal that wildlife populations in the northeast are changing at a remarkable rate; in addition to deer, many other species that predominantly depend on and use forested environments, such as black bear (*Ursus americanus*), moose (*Alces alces*), and beaver (*Castor canadensis*), also are rising to the attention of suburban wildlife management (Foster, Motzkin, Bernardos, & Cardoza, 2002). Numerous other species including Canada geese (*Branta canadensis*), and coyote (*Canis latrans*) also bring new kinds of wildlife management concerns to urbanizing areas (DeStefano & DeGraaf, 2003). Given current trends in human migration and development, human-wildlife interactions are likely to continue to grow, especially around urban-proximate parks. Perhaps with modification, the basic architecture of a conceptual model developed for the deer management system can be applied to other species that are similarly able to adapt to and utilize urbanizing landscapes near parks or other open spaces. While the specifics for each level of the system will need to be validated for each species and park-specific context, the general types of concepts remain consistent: anthropogenic activities that directly or indirectly affect wildlife, resulting changes in wildlife population dynamics and habitat availability, interactions between humans and wildlife, anthropogenic activities that affect wildlife behavior, and perceived impacts associated with human-wildlife interactions.

Restricting attention to a management frame that only partially captures the model reduces a messy problem to a complex, technical problem; misses opportunities to identify creative solutions outside agency jurisdiction; and potentially leads to unnecessary conflict. Controversies surrounding messy problems arise precisely because human values are assigned to the elements that make up otherwise complex problems. We suggest that conceptual models such as those reported in this paper can provide a starting point for dialogue-based stakeholder engagement processes, either as an outline to which greater detail can be added, or as a device for examining assumptions about problem scope and problem framing. Expanding perspectives beyond conventional problem frames to embrace the complexity of messy wildlife controversies in urban-proximate parks may ultimately result in clearer logic behind management decisions, better dialogue with stakeholders, and more durable management interventions.

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