

Activating uncertainty: Scientific evidence and environmental values in wildlife management

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Activating uncertainty: Scientific evidence and environmental values in wildlife management

Abstract: This paper examines the entanglement of science and politics through a case study of a controversy over hunting as a form of environmental management in a suburban town in the northeastern United States. Drawing on interviews with stakeholders, meeting observation, and media reports, we examine the justifications for and resistance to a municipal-level recreational deer hunting program. Our study reveals how participants activate discourses of science-based management and scientific (un)certainty (regarding deer populations, their impacts on forest ecosystems, and deer control approaches) to support arguments for and against hunting. In focusing on questions of science and rationality, the arguments of both opponents and proponents of the hunting program elide the varying human values, ethics, and emotions that underlie the deer management debate, even as they frame their positions as an act of care for the environment. In contrast to oft-cited cases where scientific uncertainty has primarily been deployed strategically by powerful actors, our analysis reveals nuance and complexity in the activation and mobilization of science and uncertainty in environmental politics and decision-making. As both hunting proponents and opponents appeal to the collection of further scientific data to resolve the controversy, we argue for greater attention to the ethical and emotional dimensions of this value-laden conflict.

Keywords: uncertainty, wildlife, values, science-based management, hunting, environmental decision-making

1. Introduction

In May 2019, a group of residents of Carlisle, Massachusetts brought a proposal to the town's annual meeting to prohibit hunting of white-tailed deer (*Odocoileus virginianus*) on town lands. Just one year earlier, the town Select Board¹ (SB) had begun issuing permits for archery hunting on public lands, framing this as a science-based management program to mitigate deer browse on forest ecosystems. The residents opposed to the program raised various concerns about the hunt, including public safety and the authority of the SB to make the decision, but their arguments primarily centered around questioning its scientific basis. They raised questions about the certainty of information about local deer numbers and impacts, and the effectiveness of archery hunting as an ecological management tool. These residents argued that archery hunting on town lands had “negligible impacts” on deer numbers and would not have the desired ecological benefits (public comments, May 2019; Minuteman Media Network 2019). They framed their opposition to hunting as environmentally motivated, with one hunting opponent saying, “please, let’s put nature and our environment first.” The town’s Conservation Commission, in contrast, voted unanimously to oppose the ban. Their representative described hunting as an act of ecological stewardship and care in the context of ecologically damaging deer numbers; as they argued, “our main concern is the health of the forest.”

The proposed ban failed, and archery hunting continued on town lands that fall. When the town’s Deer Committee suggested expanding the program the following year, opponents again raised concerns and questioned the scientific basis of the program. At least one SB member changed their view to oppose the hunting program, noting that “the science isn’t there and people don’t feel safe” (Bohn, 2020). The issue grew increasingly divisive. In July, following the resignation of the Deer Committee chair amid what a SB member later described as “nasty” discussions, the SB announced the hunt’s suspension. In a letter to the editor of the town newspaper, one resident expressed dismay about the “burgeoning deer population” and that the program had been “derailed,” while another countered that “no one knows how many deer we have” and argued that “we cannot make good decisions... without knowing what the science is telling us” (*Carlisle Mosquito*, 2020). The SB has not taken up the issue again, citing uncertainty about the scientific evidence as well as the intensity of personal acrimony over hunting. One SB member stated, “there is no room in this town for personal attacks... We need to do better as a town.” As of this writing, hunting on town lands in Carlisle remains suspended.

How did this debate over ecological management turn into such a divisive situation, and what is at stake in residents’ appeals to scientific data and evidence to resolve the issue? We take the debate in Carlisle as a case study through which we examine entanglements of science and rationality with ethics, values, and emotions. We build on work at the intersection of political ecology and science and technology studies that examines the construction, circulation, and deployment of scientific knowledges and narratives in political conflicts over environmental systems (e.g., Birkenholtz and Simon, 2022; Goldman et al., 2011, Sarewitz, 2004). Focusing on

¹ The Select Board is a common model of governance in New England towns. The SB serves as the town government’s executive branch, while legislative decisions are usually made by direct democracy via a Town Meeting. Carlisle’s SB includes five elected members serving three-year terms.

the activation of discourses of scientific (un)certainty around deer management decisions, we also contribute to a growing body of work examining the socio-political dimensions of wildlife management (e.g., Dickman, 2010, Baruch-Mordo et al., 2009; Margulies and Karanth, 2018; Epstein and Haggarty, 2022).

While wildlife management is often framed as a technical, expert-driven field, decisions about management—especially *lethal* management—involve questions of human values and ethics. Deer are highly charismatic animals, evoking compassion among some people, even as others deride them as pests or vermin. Hunting is commonly encouraged by wildlife agencies as a mechanism for management of deer populations, but also raises public concerns, provokes emotional responses, and triggers controversy and distrust. The presence of deer in the suburbs evokes competing desires and perceptions of nature. Some residents envision suburban greenspaces as shared spaces to encounter and enjoy wildlife in peace, while others see hunting as a valid use of public lands and a recreational and ecological “good.” The scientific (un)certainities that arise in debates over deer management are therefore entangled with competing social values about the role of hunting in (and as) care and stewardship for the environment.

Our study reveals how debates over wildlife management privilege the language and logics of scientific rationality, and how the centrality of data to these discussions can preclude engagement with the emotions and ethics that nonetheless animate the debate. We demonstrate how management decisions are affected by the intersections of ethics and uncertainties, particularly as uncertainty becomes a central tool to make sense of and communicate concern. This analysis of the entanglement of uncertainty, values, and emotions reaches beyond this case and questions of wildlife management, with broader relevance for understanding the role (and limits) of science in environmental management amidst political and emotional contestation.

2. Rationality, uncertainty, and ethics in environmental decision-making

Wildlife management in the United States is a highly scientific and technical practice, overseen by agencies composed of professionals with expertise in the biological sciences (Bocking, 2004; Sullivan et al., 2022). Like environmental decision-making more broadly, wildlife management is grounded in scientific rationalism and technocratic expertise, which are defining characteristics of high-modern efforts to control and manage nature in the 20th century (Scott, 1998; Morgan and Orloff, 2017). This “technocratic mentality” (Putnam, 1977) of governance emphasizes the premise that objective, evidence-based science rises above politics (Baber and Bartlett, 2001) and has long been the basis for American policy around natural resource management (Bocking, 2004; Dryzek, 2013; Sullivan et al., 2022). In this context, scientific uncertainties are often understood primarily as obstacles for managers to overcome (Birkenholtz and Simon, 2022). Colloquially, the term “uncertainty” is used to refer to an absence of information or “not knowing,” but, in a technical sense, *scientific* uncertainty refers to a lack of clarity or confidence around what a body of evidence or data shows (Brown and Damery, 2009). Such uncertainty is seen as the driver of scientific inquiry, conceptualized as “undone science” that can be filled by future research (Frickel et al., 2010; Hess, 2016) and drive better management policies and practices.

In contrast, a growing body of research addresses the social production of uncertainty and other forms of “nonknowledge.” Not-knowing is not simply the precursor to future knowledge, but the result of complex power dynamics that shape where and how knowledge is produced and circulated (Proctor and Schiebinger, 2008; Boschen et al., 2010; Rayner, 2012). Political ecologists have taken interest in the implications of uncertainty for environmental decision-making, particularly how uncertainty is cultivated and leveraged as a *resource* to strategically “increase ambiguity, cause controversy and/or delay action” (Birkenholtz and Simon, 2022, p. 157; Senanayake and King, 2021). For example, industry has mobilized uncertainty, including via the omission and dismissal of scientific evidence and the production of misinformation, to hinder regulation and displace responsibility for the impacts of climate change and carcinogenic products (McGoey, 2012; Michaels, 2008; Oreskes and Conway, 2010). Nonknowledge can also be leveraged by non-industry actors in contexts where ignorance can serve as a “tool for managing risks and exonerating oneself from blame” (McGoey, 2012, p. 3). Martin (2021) notes that having less information about animal populations and ecological conditions can be a “survival strategy” for wildlife management agencies operating amid political controversy. In the context of environmental decision-making, nonknowledge and uncertainty arise from both biophysical conditions that resist human measurement—what Kroepsch and Clifford (2021) describe as “inscrutable” spaces—and sociopolitical processes through which the legibility of environmental phenomena is produced and contested.

Questions of scientific uncertainty are therefore difficult to disentangle from other dimensions of social contestation over wildlife in the United States (Bocking, 2004). In contrast to the notion that technical expertise and rationalism allow management decisions to be made independently of politics, wildlife management is often controversial, especially when it comes to killing animals. The killing of undesirable, overpopulated, or threatening species is often normalized in conservation as an act of environmental *care* (Gibbs, 2021; Srinivasan, 2014). But killing for conservation also raises ethical concerns and its routinization has sparked resistance and debate (Gamborg et al., 2012; Minter and Collins, 2005). Recent political ecology scholarship has drawn attention to how certain animals are killed to protect other desirable species or ecological assemblages (Mazhary, 2021; Connors and Short Gianotti, 2021; Crowley et al., 2018), and some conservationists have called for greater ethical consideration of the well-being of individuals rather than species, ecosystems, and other collectives (Ramp and Bekoff, 2015; Wallach et al., 2018).

Decisions about lethal management are thus deeply *biopolitical*, relying on and reproducing social norms about which forms of life should be fostered, and what consequences are acceptable (Biermann and Anderson, 2017; Srinivasan, 2017; Chrulew and Wadiwel, 2016; Connors and Short Gianotti, 2021). The emphasis on “objective” science-based decision-making hides the normative dimensions of decisions “beneath a veil of the legitimacy of science” (Decker et al., 1991, p. 525; see also Wagner, 1995; Beck, 1998; Doremus, 2005; Sullivan et al., 2022). In this context, advocates of particular management approaches (and/or ethics) often strategically deploy technical language and data as discursive tools, or appeal to (or question) scientific expertise. Such efforts to legitimize arguments via science both respond to and reinforce the hegemony of scientific discourses (von Essen 2017, Hodgson et al 2018).

The biopolitics of wildlife management are further complicated by value pluralism regarding wildlife among a wider American public (Manfredo et al., 2018) and distrust for the actions of “expert” wildlife managers, seen by some as traditionalist and resistant to change (Beck, 1998). Sullivan et al. (2022) note a growing “values gap” between wildlife managers, who emphasize utilitarian management of wildlife as a resource, and the wider public that is increasingly oriented toward values of mutualism and coexistence (Manfredo et al., 2017). Diverse environmental groups have sought to shift power toward “the public” via ballot initiatives and collaborative, stakeholder-based approaches to wildlife governance (Beck, 1998; Nie, 2004). Wildlife management agencies thus face the challenge of promoting democratic inclusivity and participation of a heterogeneous (and sometimes distrustful) public while operating within the bounds of their statutory missions and management traditions (Lute and Gore 2014; Martin, 2021). Distrust for managers is compounded by agencies’ attention to the interests of hunters and therefore management of game species (Feldpausch-Parker, et al. 2017; Eichler and Baumeister 2018; Treves et al. 2017), which is intertwined with the financial model of American conservation that relies on hunting fees and excise taxes on guns and ammunition to fund wildlife agencies (Casellas Connors and Rea, 2022). Amid such disputes over the legitimacy and authority of management, uncertainty may be a powerful resource to be harnessed in political debate. At the same time, given the history of strategic cultivation of uncertainty (particularly in the form of climate denialism), even sincere and legitimate concerns about scientific evidence may be (mis)perceived as political tactics to stoke doubts (Lynn et al., 2019).

Moreover, the ethical dilemmas of conservation raise strong emotional responses, including feelings of sympathy and grief for animals, and related anger directed either toward those involved in killing or those seen as preventing desirable ecological management actions (Godoy, 2020; Batavia et al., 2020). Yet both scholars and practitioners of conservation are often reluctant to speak of emotions, steeped in the “pervading perception... that human emotions are irrational and subjective” (Stinchcomb et al., 2022). The tendency to treat wildlife decision-making as purely rational and scientific obscures and delegitimizes these emotions and the contested values that underlie them (Buijs and Lawrence, 2013; Wynne-Jones, 2022). Recent work in the field of “emotional political ecologies,” by contrast, draws attention to the important role of emotions in the politics of environmental management (Sultana, 2015; González-Hidalgo and Zografos, 2020; Epstein and Haggerty, 2022)

Since deer populations and impacts are difficult to measure precisely, debate over deer management in the northeastern suburbs of the United States exemplifies how uncertainty about wildlife dynamics can be enrolled in biopolitical and emotional contestation. Belying the notion that scientific management is apolitical, many have described deer management as a “wicked problem” due to the intractability of competing values toward deer and hunting (Curtis, 2020; Westerfield et al., 2019). As highly charismatic animals, deer are readily enrolled in anti-hunting discourses, including the anthropophobic environmentalist narratives critiqued as the “Bambi complex” (Lutts, 1992). At the same time, deer are “made killable” via the production of discourses of “overabundance” (Connors and Short Gianotti, 2021) that position deer as both an ecological concern and a threat to human health – the latter contributing to heightened emotional responses (Epstein et al, 2021). Opponents of hunting have challenged the objectivity of state

agencies due to their reliance on fees from hunting, and have also questioned claims about deer overabundance, “suggesting uncertainty in the science or even falsification of results” (Connors and Short Gianotti 2021, p. 12). These political dynamics are entangled in environmental imaginaries of unaltered or “pristine” ecological conditions, even amid significant anthropogenic alterations (Connors and Short Gianotti 2021; Marris, 2011; Lorimer, 2015). In this way, appeals to scientific management for “healthy” ecosystem dynamics may similarly serve as a veil that obscures the underlying biopolitical dimensions of deer management.

In this paper, we engage with questions of how scientific (non)knowledge, values, and human emotions interact in shaping environmental decision-making processes. The emotional intensity of the debate over deer management in Carlisle, MA signals that it cannot be fully understood simply as a question of rational or purely scientific management. Without discounting the importance of scientific knowledge for making environmental management decisions, we recognize that “the categories ‘political’ and ‘scientific’ often overlap” (Birkenholtz and Simon 2022, p. 156), and that appeals to scientific management should not “necessarily preclude politics from coming to bear on decision-making” (Sullivan et al., 2022, p.8). By examining the emotional and ethical political ecologies of deer management in the Massachusetts suburbs, our work aligns with calls for deeper attention to the role of varying environmental values and desires in environmental decision-making (Sullivan et al., 2022; Biermann and Anderson, 2017; Robbins and Moore, 2013).

3. Methodology

This paper draws on seven years of sustained engagement by our research team with the issue of deer management in Massachusetts. Here, we focus on the debate over archery hunting on town lands in Carlisle, MA. We attended or reviewed videos from public meetings over the period of 2015 to 2023 and reviewed related planning documents and reports to examine the range of publicly expressed perspectives on deer management decisions. We also conducted 16 semi-structured, in-depth interviews with stakeholders in Carlisle, including officials involved in decision-making (members of the town’s Deer Committee, Conservation Commission, and SB) and residents who supported or opposed the hunting program. We conducted additional interviews with officials from state agencies and communities across the region. We purposefully selected interviewees based on their familiarity and experience with deliberations about deer management, while aiming to represent a diversity of perspectives.

After coding and analyzing the data from these interviews, meeting notes, and other documents and developing a draft manuscript, we returned to the community to conduct a community peer review process, asking participants to provide feedback on our interpretations of events and dynamics in Carlisle. Our process builds on, but also differs from, approaches aimed to ensure self-determination and/or to afford the refusal of research in the context of extractive and colonial relations common in research (Liboiron et al., 2018). We did not expect or seek to reach a consensus within the community, either regarding deer management decisions or the role of our research in addressing community concerns. We did, however, aim to ensure the accuracy of our representation in this paper of perspectives held by the community and afford community

members an opportunity to share additional insights and concerns about the research process and findings.

Our analysis of the debate over deer management focuses on scientific uncertainty, as a key theme of interviews and a central driver of the decision to suspend the deer hunt. We emphasize how uncertainty was activated and garnered saliency in discussions about deer management. We strive to reflect the dynamics of this debate over scientific uncertainty from an outside perspective, rather than taking a stake in it or endorsing one position or another. While we make no claim to complete neutrality, recognizing the limits of scientific objectivity (Haraway, 1988) and the inextricably power-laden nature of research, our work seeks not to adjudicate the claims made by either side of the debate, but to offer a reflection on the decision-making process that we hope will build mutual understanding among participants, as well as contribute to broader discussions on the politics of environmental governance and management.

4. Science, uncertainty, and skepticism about deer management in Carlisle, MA

4.1 From extirpation to (over?)abundance

White-tailed deer are both a conservation success and a management challenge. Hunted nearly to extinction during the 19th century, deer populations rebounded across North America in the 20th century (Westerfield et al., 2019). This growth has been pronounced in the suburbs, where deer move between forest patches and residential backyards, benefitting from plentiful food, the absence of predators, and limited hunting (Gaughan and DeStefano, 2005; Curtis, 2020). While some people welcome deer in their neighborhoods, many others raise concerns about vehicle collisions, damage to agriculture and landscaping, and Lyme disease (Curtis, 2020; Westerfield et al., 2019), as well as impacts on forest regeneration and assemblages of wild plant and animal species (Côté et al., 2004; Gorchov et al., 2021).

Amidst growing public concerns about deer impacts, municipal decision-makers across the state have explored management actions in coordination with the state wildlife agency, MassWildlife (Edelblutte et al., 2021; Connors and Short Gianotti, 2021). MassWildlife adheres to a strict interpretation of the North American Model of Wildlife Conservation, under which wild animals are considered a public trust resource managed by states for the sustained benefit of the (hunting) public (Organ et al. 2012; Heffelfinger et al., 2013). They therefore disallow culling by professional sharpshooters, relying exclusively on lethal take by “the public” (hunters) for deer population management. Though some opponents of hunting advocate for non-lethal reproductive control measures, these methods are very expensive and unlikely to be effective in this landscape (Rutberg, 2019). Moreover, they are only permitted in Massachusetts in the context of state-approved scientific research and thus are not an option for municipalities, making recreational hunting the only available population management tool. Although state agencies hold formal authority to manage wildlife, the density of private parcels, buildings, and roads limits the capacity to access lands for hunting, thereby reducing agency control over wildlife populations (Edelblutte et al., 2021, 2023; Haggerty and Travis 2006). At the invitation of municipalities, MassWildlife routinely gives public presentations and consults with towns to support expanded hunting access for deer control.

Carlisle is one of several suburban communities in Massachusetts that has explored volunteer hunting as a strategy for deer management. Carlisle is a small, affluent suburb, about 20 miles northwest of Boston, with a population of just over 5,000 and a median household income of \$216,000 (U.S. Census Bureau, 2021). Zoning regulations in the town favor large lot sizes (minimum lot size of two acres for most of the town) and the town has over 1,100 acres of conservation land. Residents describe their community as environmentally minded (“Carlisle, to maybe a greater degree than other towns, cares about the environment;” interview, July 2021) and well-educated (“there are a lot of people here who are trained in critically evaluating information and weeding out misinformation;” interview, November 2021).

In 2015, the Carlisle Board of Health raised concerns about the prevalence of Lyme disease and the possible connections to growing deer populations. The Board organized an expert panel that included representatives from a neighboring town and MassWildlife. Although MassWildlife encouraged the expansion of deer hunting, they emphasized the benefits for reducing the impacts of deer on forests rather than human health. Amid growing consensus about the ineffectiveness of deer management for addressing Lyme disease, concerns about deer’s ecological impacts superseded concerns about deer’s relationship to Lyme.² The SB formed a town Deer Committee in 2016 to examine options for municipal deer management and authorized a pilot archery hunting program on town lands beginning in 2018 (without returning to town meeting for further authorization, which some parties expected). The proposal to ban hunting in 2019, and the subsequent debate highlighted in the introduction of this paper, took place at the height of several years of discussions over deer management in Carlisle. These discussions highlight both (dis)trust in technocratic managers’ expertise and the role of scientific data and uncertainty in environmental decision-making.³

4.2 Centering scientific evidence

Much of the debate over deer hunting in Carlisle has centered around ecological data—or in the view of some stakeholders, the absence, insufficiency, and/or illegitimacy of that data—as evidence for management actions. Proponents frame hunting as an effective and necessary component of science-based ecological management. Opponents emphasize the lack of scientific studies and data to assess the need for or efficacy of hunting to manage deer in Carlisle, or even argue that the scientific evidence contradicts the calls for hunting. In this way, both parties agree that scientific evidence is central to decision-making yet present competing views about the

² While public concerns about Lyme disease remain widespread, there is limited evidence that reductions in deer populations would reduce Lyme prevalence; however, the relationships between disease, ticks, and deer management are complex and unsettled (Levi et al 2012, Kugeler et al 2015, Kilpatrick et al 2014). The shift in emphasis from Lyme disease to forest impacts is cited by opponents of the hunt as evidence of an underlying desire to justify hunting by any means necessary. However, stakeholders in Carlisle do not contest the scientific evidence around the claim that Lyme cannot be effectively addressed through deer management.

³ Our opening emphasis on events in 2019-2020 is not a comprehensive summary, but an evocative vignette representative of discussions in Carlisle from 2015-present. For another account, see the town Open Space and Recreation Plan (Freedman et al., 2020), or videos and minutes of meetings available at <http://www.carlislema.gov>.

sufficiency, trustworthiness, or relevancy of existing evidence in Carlisle specifically. These debates over the interpretation of scientific data span three themes: the size of the deer population in Carlisle, the impacts of deer on Carlisle's forests, and the effectiveness of the hunt as a management tool.

First, town officials who supported the hunting program describe deer as "overpopulated," referring to estimates conducted by MassWildlife: "We can safely say, we're over [the number that] would be recommended" (interview, Deer Committee member, August 2021). This perspective is echoed by MassWildlife officials and the agency's website (see Massachusetts Division of Fisheries and Wildlife, n.d.). Opponents of the hunt, however, contest the data provided by MassWildlife, arguing that there is "no true evidence that Carlisle has a deer overpopulation problem" (interview, July 2021) and that "we don't know how many [deer] we have" (interview, July 2021). Opponents have repeatedly called for localized data, arguing that MassWildlife has treated overpopulation "as a given" based on broader regional concerns (interview, July 2021).

Second, hunting proponents emphasize the ecological threat of deer, arguing that deer impacts are "becoming more and more evident" and that deer are "having an adverse effect on native forest regeneration" (interview, August 2021). MassWildlife uses observations of vegetation browse rather than direct counts of deer to assess management needs and outcomes (Stainbrook, 2019). The agency conducted browse surveys in Carlisle and concluded that deer are significantly impacting forest health. Opponents of the hunt, however, argue that "there has not been any evidence presented that [deer are] causing severe or irrevocable damage to our understory" (interview, July 2021). They describe MassWildlife's survey of deer impacts in Carlisle as "just impossibly cursory... absurd" (interview, July 2021) and point to inconsistencies between MassWildlife's stated methodology for browse surveys and the work that was done on the ground. One opponent developed an independent ecological monitoring protocol for assessing deer impacts, and submitted a report to the town Conservation Commission arguing that MassWildlife has significantly overstated deer impacts on town lands. Opponents of the hunt point to this unpublished report to counter MassWildlife's claim to authority around the data evidencing deer browse impacts.

Third, hunting proponents frame hunting on town lands as an effective mechanism for managing deer numbers to maintain "the appropriate deer population" (interview, Deer Committee member, August 2021). Opponents of the hunt question the efficacy of archery hunting for population reduction. Noting the limited scale of the recent program (fewer than 10 deer killed per year), they suggest that proponents are misrepresenting the efficacy of the program: "to reduce the population, you have to kill more deer than are born and survive each year. So killing six deer, especially [if] we have this massive overpopulation that's been presented, it's going to do zero to control the population" (interview, July 2021). Some opponents of the hunting

program thus suggest culling deer using professional sharpshooters as a much more effective tool for population management.⁴

On all three of these points, both sides lay claim to scientific rationality. Proponents of the hunt proclaim trust in the assessments of wildlife managers that support hunting as scientific management, while opponents question the accuracy and completeness of those assessments and question the motivations of MassWildlife. Though some opponents of the hunting program carefully distinguish between these three areas of concern, emphasizing one or another, many opponents move between all three areas and characterize the entire endeavor to justify hunting as “unscientific.” As they put it, “science just wasn’t coming into it” and “we didn’t have credible evidence that we actually had a problem... a lot of unwarranted assumptions were being made that weren’t grounded in solid evidence” (interview, July 2021). Many opponents of the hunt have repeatedly called for more research to “accumulate the scientific evidence” before implementing policies so that management can “be done scientifically, quantitatively, and with the truth” (interview, August 2021). Proponents of the hunt, in contrast, point to MassWildlife’s assessments to assert that action is necessary and any reductions to the deer population are beneficial.

Both sides of the debate refer to scientific experts to support their position. Hunting proponents appeal to the work of David Stainbrook, the MassWildlife biologist who recommended hunting to address deer overpopulation. Hunting opponents refer to the work of Dr. Allen Rutberg, a wildlife ecologist who researches fertility management in wild animals and has questioned the efficacy of recreational bow hunting as a management tool. Both scientists have presented their perspectives at community meetings in Carlisle (Stainbrook, 2019; Rutberg, 2019).

As one Deer Committee member noted, the decision-makers tasked with addressing the issue in Carlisle have limited resources, are not expert scientists, and are

“very much relying on the information that MassWildlife have been giving us... and that is obviously a point of controversy, because a lot of times people who oppose hunting for various reasons have been using that as an argument against going forward [with hunting], because... they’d like their own data. And of course, generating the data is... very expensive” (interview, August 2021)

From this member’s perspective, calls for more research were intentionally being raised as a mechanism for delaying and disrupting the hunting decision rather than amounting to a legitimate scientific concern, describing the “mantra” of “Where’s the evidence? Where’s the evidence?” as an effort to overwhelm town officials with “intentionally impossible demands” (interview, August 2021). Some SB members, however, grew sympathetic to concerns about the lack of local data, contributing to the decision to end the hunting program. For proponents of the program, the decision-makers succumbed to artificial, politically manufactured uncertainties,

⁴ Some opponents of the hunting program support culling deer via professional sharpshooting, and interpret the effective prohibition of culling in Massachusetts as evidence that the underlying goal for MassWildlife is not deer management but the expansion of recreational hunting. Others are firmly opposed to both hunting and culling.

deployed by activists seeking to stall needed action. For opponents, the same decision is seen as a victory for rational, scientific management in the face of efforts by the state's wildlife agency to use manufactured "science" to expand hunting across the state.

4.3 Sidelining ethics and values

Both sides of the debate over deer hunting in Carlisle lean into the framing of the debate as a question of science-based management and call upon data (or the lack thereof) to support their views. Yet both sides simultaneously frame their counterparts on the other side of the issue as motivated by underlying biases based on personal values, interests, or ethics, while downplaying the role of such things in driving their own actions and positions. For example, proponents of hunting characterize the anti-hunting perspective as rooted in ethical opposition to the killing of animals. One proponent describes the opposition as "animal rights folks" who "believe that all life is precious, and therefore any sort of hunting is unethical" (interview, August 2021). Other hunting proponents suggest that the opposition gained ground because "a lot of people just think deer are so cute" (interview, August 2021), thereby implying the role of the "Bambi complex" at work in the emergence of opposition to hunting, and implicitly undermining the rationality of opponents of the hunt.

In contrast to this characterization, opponents themselves rarely mention animal rights or welfare as a motivation. Some emphasize concerns about safety and access, arguing that residents do not feel comfortable using public lands for recreation during hunting season. Most are emphatic, however, that the absence of scientific evidence to justify management is their overriding, central concern. A single interviewee notes moral concerns related to hunting, saying "I hate to see animals killed... as I told you, I'm a vegetarian" (interview, July 2021), but many others outright reject being labeled as "animal lovers," or as opposed to hunting in general. As one puts it, "I'm personally *not* opposed to deer hunting... [I don't] think it's an abomination, and cruel, and all that... I'd be fine with it if it was just presented as recreational hunting, and if it has an effect on deer [populations], fine. But... [there's] a lot of evidence that it won't be effective [for population reduction]" (interview, August 2021). In this way, those opposed to the hunting program turn back toward critiquing the scientific rationale for hunting as deer management, rather than engage on ethical terms about the killing of deer.

Moreover, many opponents characterize the hunting program as an "unscientific" endeavor motivated by proponents' underlying desires to increase recreational hunting opportunities in Carlisle. As one opponent explained, "advocates [of hunting] basically saw the resistance growing against recreational hunting, and rebranded recreational hunting as 'save the forest' hunting... I think it's very cynical, and I'm very... suspicious of that" (interview, August 2021). From this perspective, hunting proponents retroactively justified their "agenda to open up town lands to hunting" in terms of ecological concerns (interview, July 2021). Opponents of the hunt offer these views in tandem with skepticism about the motivations of MassWildlife, who opponents perceive to have a conflict of interest since the agency receives revenue from the sale of hunting licenses and permits (Author, in review).

In this context, some critics see the SB's decision to open public lands to archery hunting as an "abuse of power" and "authoritarian decision" made by the SB, based not on science but on the goals of a particular interest group, with minimal opportunity for public input (community peer review, March 2023). They argue that claims about deer causing widespread ecological damage are based on "no facts... just this sense [of deer overpopulation] that was fueled a lot by [MassWildlife]" (interview, July 2021). One opponent of the hunt describes a shift in their motivations from an initial concern about animal rights to concerns about MassWildlife's conflict of interest: "in the beginning, I came from the, 'well, this is inhumane' [perspective] and then I actually ended up doing a lot of research, and now I'm coming from a much bigger, kind of like, 'Wait a second. Yeah, we are being bamboozled here' perspective" (interview, July 2021). Skeptical residents assert that this is part of a larger pattern and that MassWildlife has "a long history of propaganda" to advance the "assumption that hunting is a solution" to the deer issue (interview, July 2021). They frame the debate in Carlisle as a site of resistance in a broader struggle against the expansion of hunting across the region, describing MassWildlife's strategy as "when you persuade one town [to allow hunting], you use that to help persuade others" (community peer review, March 2023).

Finally, several opponents of the hunting program raise concerns about human intervention into ecological systems. They note that the source of the deer "problem," to the extent that they see it as a problem at all, is the encroachment of suburban development into deer habitat and the abundant food for deer in the suburbs. They suggest that deer are being punished for human actions. Many further argue that human interventions to "fix" ecological problems are themselves the problem: "we shouldn't be playing God" (interview, July 2021) and "whenever human beings try to fix nature, they invariably blank it up... I'll leave it to you to fill in the blank" (interview, July 2021). These concerns about anthropogenic change and human hubris are accompanied by skepticism of information circulated by "expert" managers. In this way, distrust for local and state authorities, concerns about human intervention into ecological systems, animal welfare considerations, and concerns about scientific evidence may all be mutually reinforcing, even as the latter stands prominently at the center of public debate.

4.4 The place of emotions in decision-making

Over a few years, what to do about deer in Carlisle evolved from an open inquiry to an acrimonious town debate that, in the words of one municipal official, "is hurting the town because it sucks all of the oxygen out of more important issues." Parties on both sides of the issue observe how rapidly it became divisive and personal. In the words of one Deer Committee member, the debate was "hugely controversial, and frankly, divisive and nasty" (interview, August 2021); others describe the issue as "fractious," "very emotional," and "muddy and ugly," with "contentious exchanges" and "ad hominem attacks" between participants.⁵ For many, the emotionality of the debate was seen as a barrier to reasonable conversations about the science: "it ends up being sort of an emotional discussion, as opposed to a factual discussion... no matter how much they try to be data-based, you get drawn into emotional arguments" (interview,

⁵ Despite this recurrent theme, some interviewees disagree with the characterization of acrimonious conflict, arguing that public discussions generally remained within a professional and courteous tone.

August 2021). The intensity of the debate, and especially the escalation to personal attacks, is described by several interviewees as preventing “rational” engagement over the scientific issues at hand.

Some interviewees suggest that the debate became emotional precisely because the issue of deer hunting is not simply scientific or rational but related to deep-seated personal beliefs. As one resident put it, “it's like attacking someone on religion, it just gets very emotional very quickly.” They noted that there was very little room for a middle-ground position in the discussion: “if you believe that the understory is being degraded, and it'll never come back, then you... want to do something. And if, on the other hand, you think... killing animals is bad, then... there's no common ground to be found” (interview, August 2021). In this way, the intensity of the debate may have arisen at least in part because the issue of hunting raises questions of underlying personal ethics and values, rooted in competing notions of how best to care for the natural environment.

Labeling opponents as “emotional,” however, also works as a means of dismissing arguments in the context of the stigma associated with emotions as unscientific. In fact, many opponents of the hunt reject outright the characterization of their position as based in ethics or emotions at all. For example, one resident argues that “animal welfare does not play a part in the reason people oppose the hunt... Sincere and legitimate requests for data-based decision making [are] at the core of the opposition reasoning, [which is] not a tactic or emotional pearl-clutching but a rational approach to decision-making” (community peer review, March 2023). Others acknowledge that personal values play some role in motivating their stance, but similarly emphasize the importance of science-based management as the underlying question:

“This is not a laughing matter, killing living creatures. I mean, if you're going to kill living creatures, you better have a damn good reason for doing it... [but] if I had done the homework that I've done, and it convinced me that... the deer are destroying our forests, and that bow hunting would fix the problem, I would have said that... in spite of how I feel emotionally about killing animals, if I thought there was an environmental case, a real environmental case for those hunts, I would have said so.” (interview, July 2021)

Notably, the question of what constitutes “a real environmental case” for hunting relies, for both parties, on the expectation that the dilemma can be answered via better data and the application of rational decision-making processes. Without denying the importance of the scientific questions raised in the debate, we note that the threshold of evidence that would be accepted in support of the “environmental case” is significantly different between advocates and opponents. The repeated foregrounding of questions of evidence and emphasis on science-based management tends to obscure the value-laden character of the issue.

The emphasis on the absence of scientific facts, on both sides of the argument, is often made in tandem with references to the political context around questions of fact in American society. For one opponent, the justification for hunting based on deer overpopulation “feels very Trumpian... they want it to be a fact, so they just speak of it as if it's a fact. And the more they repeat it, the

more [it] might be accepted: ‘Oh yes, the Carlisle deer overpopulation’” (interview, July 2021). Another opponent of the hunt makes a similar claim, describing MassWildlife’s efforts to promote hunting as “misinformation”: “remember what era we have lived between 2016 and 2020, right? With an administration that makes decisions really not based on any kind of data or scientific argument” (interview, August 2021). Meanwhile, some proponents of the hunting program argue that it is the “philosophy that we shouldn’t be killing any animals” that is fundamentally unscientific, comparing the opposition to hunting to the anti-vaccination movement: “they have no science... there’s no science to me” (interview, August 2021).

Some opponents of the hunting program describe the decision to suspend hunting as a victory for science, saying that “even some of the pro-hunting members of the Select Board... began to realize that... they just didn’t have a good enough understanding of what they were doing,” and that some people’s views “have changed based on facts and science” (interview, July 2021). SB members, however, are more equivocal, sometimes acknowledging the hope to obtain more localized ecological data as an important consideration, but also framing claims about uncertainty less as a legitimate, serious concern than as an obstacle to effectively resolving and moving on from the issue. As one SB member said, “it’s not worth all this angst and disruption and disharmony [when] nobody knows what they’re talking about... without enough information about why we’re doing this, we’re just talking about potshots from the bushes” (interview, September 2021). SB members tend to emphasize the personal attacks and tense emotional experience of the debate itself as the foremost reason for suspending the hunt.

5. Interpreting the activation of uncertainty amid environmental debate

Our research demonstrates how both proponents and opponents of hunting in Carlisle focus their arguments around scientific knowledge about deer management. Claims about scientific evidence regarding the ecological impacts of deer are routinely marshaled to support hunting, while uncertainties and/or insufficiencies of data are activated to counter those claims. Largely through appeals to scientific uncertainties, opponents of the hunt effectively altered the decision-making process, leading to the program being put on hold. Notably, both sides of the issue in Carlisle express a belief that science is on their side, and appeal to data (or its absence) out of concern for doing things “scientifically.”

In contrast to other cases where scientific uncertainty has been leveraged (see Oreskes and Conway, 2010), the opponents of hunting in Carlisle are not disingenuously sowing doubt through misinformation or the omission and subversion of scientific facts, nor do their arguments tend to serve the interests of powerful industries or other actors. These residents themselves frame this example as an inversion of those well-worn roles, describing the information provided by MassWildlife as misinformation or even “propaganda” motivated by interest groups aiming to expand hunting. Activist political movements often aim to “speak truth to power;” by contrast, residents concerned about hunting in Carlisle position themselves as “speaking uncertainty to power,” and position nonknowledge about deer numbers, impacts, and management as “undone science” that undermines the rationale for hunting as science-based management. Yet conversely, there is also scarce evidence to suggest that those supporting the Carlisle hunt are acting in bad faith, represent a nefarious plot to expand hunting, or are themselves

misrepresenting scientific facts. Proponents understand hunting as an effective and justified tool of science-based management in the face of a significant ecological threat. In this way, both sides of the argument appear genuine in their appeals to science, even as their perspectives on the science inevitably intersect with their other motivations for or against hunting.

Despite this, individuals across the debate present the opposing side as problematically driven by an agenda based on personal values, ethical positions, and/or desires, interpreted as a failure or corruption of science-based management. Opponents of the hunt largely believe that proponents are primarily motivated by expanding hunting; conversely, proponents largely believe that opposition is primarily about ethical objections to killing animals. Both sides see their own engagements with scientific data and uncertainty as legitimate arguments for science-based management but interpret their counterparts' uses of data and uncertainty as political "tricks" to advance their agenda, by actively producing misinformation or harnessing uncertainty as a strategic resource (compare Birkenholtz and Simon, 2022).

In particular, advocates suggest that opponents of the hunt deployed scientific uncertainty intentionally and strategically, as a tactic to delay or prevent hunting. While some opponents acknowledge that their efforts were strategic, aimed at making their case to their neighbors, and that they used the available rhetorical devices at their disposal, they firmly reject the claim that their opposition was in any way disingenuous in raising concerns about scientific evidence. In our community peer review, several opponents of the hunt expressed concern that this paper presents scientific uncertainty as a strategic "tactic," or as an instance of "obstructionism," as opposed to the raising of legitimate scientific questions; they in turn described hunting advocates as the ones "strategically" distributing misinformation about deer management. Our point here is not to make a claim about intentionality or strategy on the part of any actor, but to note that both sides consistently *perceive* the other as using unfounded science strategically to make a case for a particular policy, a perception that reveals deep-seated, mutual concerns about the use and misuse of scientific facts and framings. Without endorsing either position, we agree with Carlisle residents that the debate over hunting in Carlisle extends beyond a dispute over the sufficiency of scientific data. This narrow framing obscures the role of values, ethics, and desires, restricting the acceptable realm of discussion of deer management to questions of scientific evidence.

These broader motivations are apparent in the repeated appeals to *care* for the natural environment, which represent competing visions rooted in distinct but unstated environmental ethics (see Gibbs, 2021; Srinivasan, 2014). Even as they fall within a shared commitment to environmental stewardship, such differences are biopolitical, reflecting tensions between promoting the wellbeing of individual animals, fostering populations of desirable species, and/or promoting dynamics that support ecological health, resilience, and diversity (see Crowley et al., 2018; Srinivasan, 2017; Biermann and Mansfield, 2014). The debates over hunting also capture competing visions of human intervention to repair ecological processes that have been transformed through human actions (Robbins and Moore, 2013). For example, several opponents frame hunting as human hubris in attempting to control ecological dynamics, invoking the precautionary principle to argue that killing deer should not be allowed in the absence of overwhelming evidence to support it. Hunting proponents use a similar logic, however, framing

human inaction as an active choice *not* to manage a major threat to forest health. Notably, both arguments rely on assumptions about “natural” (and thus desirable) ecological conditions, including deer populations and forest regeneration dynamics, against which human interventions are juxtaposed, with little recognition of the significant anthropogenic transformations to environmental processes in suburban socio-ecological systems.

The emotions and distrust arising in Carlisle underscore how hunting and other environmental management controversies raise questions that are not simply scientific. Though both proponents and opponents of the hunt have highlighted emotionality as a failure of “rational” scientific management, we note that decisions entailing personal beliefs and values are bound to evoke strong emotional responses. Wildlife management, especially when it entails lethal control, goes beyond implementing science-based decisions, and requires interrogation of differences in values that are intertwined with emotional experiences and the production of social relations among humans and nonhumans. Rather than being denigrated or dismissed as inconsistent with scientific management, which is likely to further conflict, emotionality is best understood as an expected part of the process of negotiating fraught and value-laden questions—that is, part of the emotional (and *ethical*) political ecology of wildlife management.

These competing environmental care ethics have rarely been discussed publicly in Carlisle, but this need not be interpreted as the concealment of a “secret agenda” by either party. Rather, residents and town officials have sidelined such considerations through a shared emphasis on the importance of science-based decision-making. In the context of a collective community identity emphasizing the validity of science, participants in the debate have constructed a shared notion that scientific evidence should be the focus of the discussion and the only legitimate basis for decisions. Without social norms for open discussion of ethics or values, residents return to data-driven arguments to participate and have influence in decision-making, and frame anything “unscientific” in their counterparts’ positions as evidence of a weak or biased argument.

The Carlisle case is illustrative of how approaches to decision-making and strategies for action take shape. When faced with social conflict, people generally confront challenges using familiar approaches and practices to navigate processes of civic and political engagement (see Swidler, 1986; Carlson, 2023). In Carlisle, the commitment to science-based, data-driven decision-making has defined acceptable practices for engagement in civic forums of democratic decision-making. Residents’ challenges to the scientific rationality of others’ arguments, and tendency to devalue or dismiss emotional responses, are both shaped by and reiterative of the norms of civic engagement that bound the acceptable forms of knowledge and debate. Such norms of political participation have largely relegated questions of values and ethics to the domain of emotionality, which is seen as antithetical to scientific inquiry. In this context, appeals to uncertainty or absence of evidence are the primary civic tools (Carlson, 2023) recognized as acceptable grounds and mechanisms for disagreement.

Amid changing socio-environmental conditions, and mutual distrust and fears about misinformation, the residents of Carlisle are seeking to make sense of their social and political environment. Appeals to science-based management have arisen as the primary tool for engaging in decisions about social-ecological relations, but the activation of scientific knowledge and

(un)certainty as the key considerations in environmental decision-making (compare Senanayake and King, 2020; Birkenholtz and Simon, 2022) limits the possibility for engaging other rationales for and against hunting. Uncertainty may therefore function as a proxy for ethics or other value-laden considerations, with actors emphasizing uncertainty because there is little space for debate on any other terms. In this way, the contestation over scientific (un)certainities in Carlisle is a process through which competing environmental imaginaries are expressed, but never quite made legible, and the moral and political dimensions of deer-related decisions are hidden behind the appeal to objective, unbiased scientific management.

As the community of Carlisle grew increasingly divided over the issue of hunting, scientific uncertainty was used by decision-makers themselves, who used it not as an argument for or against hunting, but as a reason to put the entire painful topic behind them. They justified this by reference to the inscrutability of deer populations and impacts (Kroepsch and Clifford 2021), in the context of their own limited resources and lack of capacity to resolve the complex scientific questions being raised. Their displacement of responsibility to the scientific experts may have amounted to a “survival strategy” (Martin 2021), but it was paired with hope that the acquisition of more scientific data can someday facilitate an easier (that is, less emotional) discussion to occur. Stakeholders on both sides of the divide thus turn back toward rationality and science to provide a way out of a difficult decision, framing the certainty of scientific data as an antidote to politics, as they await ongoing research characterizing deer browse impacts on forest ecosystems in Carlisle and surrounding communities. Proponents and opponents of the hunting program repeatedly describe themselves as open to changing their positions, but it remains to be seen if new scientific data will ever be accepted as trustworthy or sufficient to change minds. Moreover, the question of what ought to be done will always be political even when faced with seemingly certain information, as scientific data alone should not be expected to bridge an emotional and value-laden divide.

6. Conclusion

Scientific evidence and certainty are commonly framed as central to decision-making in liberal democracies, delineating fact from politics. The controversy over deer management in Carlisle, MA, however, highlights the entanglement of science and politics in contemporary environmental challenges. In other widely discussed examples of such entanglements, such as climate change or consumer health, powerful actors motivated by deep financial interests have deployed scientific uncertainty to dissuade and obstruct action, causing those who seek to protect the public and the environment to appeal to objective, scientific fact to rise above the political fray. This social context simultaneously contributes to concerns about the misuse of science as justification for management actions, and engenders skepticism of scientific claims, even as it reinforces the pervasive sense that scientific facts can ultimately lead to the right management decisions. The activation of scientific uncertainties around deer management in Carlisle is not insidious in this way, however, nor is the role of scientific truth so clear-cut. Both parties to the debate over deer hunting on public lands in Carlisle leverage scientific facts and uncertainties as *resources* (Birkenholtz and Simon, 2022) that serve to support desired management outcomes. Yet although the actors are motivated by different personal interests, values, and desires, they are

not evidently operating in bad faith, despite frequent mutual accusations of obscuring facts and peddling falsehoods. Individuals on both sides of the disagreement have a genuine belief that better scientific knowledge could help provide a consensus or amicable compromise.

Yet scientific facts and certainties, important as they are, are unlikely to fully resolve the contestation over deer hunting. As the Carlisle case demonstrates, wildlife management entails value-laden questions about how best to “put nature and our environment first,” a goal that both sides of the argument agree on, even as they disagree over what it means. The collection of additional scientific data cannot answer underlying questions about how best to care for the socio-ecological systems of Carlisle, which raise issues of human-nonhuman relations and ethics that reach beyond the purview of the ecological sciences. While the emergence of new ecological data should therefore not be expected to resolve all controversy, it may be a generative opportunity for the development of a more nuanced conversation about the complex and intertwined scientific and value-based dimensions of wildlife management.

In contrast to the common paean for rational, scientific management that rises above politics, this case study shows how environmental managers and decision-makers must grapple with the value-based dimensions of their decisions and decision-making processes. This requires facilitating conversations about environmental ethics, such as forums for discussion of ecological management decisions in terms of competing values and ethics of care for nonhuman life and the natural world, rather than simply scientific data and evidence. It also requires interpersonal engagement and emotional labor on the part of all stakeholders to make spaces in which it is possible to lay personal values and beliefs on the table for discussion. We make no claim that such spaces and labors will eliminate conflict over deer management or any other contested environmental debate. We do argue, however, that a deeper attention to values and ethics, and their entanglement within questions of scientific management, can help decision-makers better understand the stakes of their choices. An exclusive emphasis on scientific facts and data as drivers of environmental management decisions, and the associated dismissal of personal values and emotional experiences, may fuel conflict because it fails to resolve, and may even exacerbate, interpersonal and value-laden differences. By acknowledging how management questions that may appear at first glance to be purely rational and scientific in fact raise competing ethics of care for the natural environment, environmental managers and decision-makers may create space for less divisive disagreement over controversial issues.

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