PERSONAL NORMATIVE INFLUENCES ON DEER HUNTER PARTICIPATION IN CHRONIC WASTING DISEASE (CWD) PREVENTION

A Thesis

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ABSTRACT

White-tailed deer are an important species in New York, but chronic wasting disease (CWD) threatens the many benefits derived from white-tailed deer. CWD is a fatal prion disease within the same category of diseases as mad cow disease. New York is currently CWD-free, but the disease has been spreading throughout the United States and was recently found in a county of Pennsylvania bordering New York.

The New York State Department of Environmental Conservation (NYSDEC) has identified CWD prevention as a management priority. NYSDEC suggests deer hunters take risk-minimizing behaviors to help keep CWD out of New York. In this study, I demonstrate the role of deer hunters' personal norms as a key factor influencing their intentions to perform CWD risk-minimizing behaviors. I use norm-activation theory (NAT) as a conceptual framework to explore the influence of personal norms and the factors leading to activation of personal norms.

I find that CWD risk perceptions have a distant and mediated effect on hunters' intentions, while perceived efficacy of the risk-minimizing behaviors (to help keep CWD out of New York) consistently has a positive and direct impact on deer hunters' personal norms *and* intentions. Research has invariably found perceived efficacy to positively affect hunter intentions to support or participate in CWD management (including prevention). Reducing underlying scientific uncertainty about the effectiveness of management actions should be prioritized in continued efforts to unite deer hunters, wildlife managers, and disease exerts around CWD management efforts.

BIOGRAPHICAL SKETCH

Deanna D. Kreinheder is a master's student in DNRE co-advised by Bruce Lauber and Rich Stedman. Her master's project has allowed her to contribute to integrating social sciences and natural resources management. She has a BS in Wildlife Science from SUNY-ESF and previously worked as a wildlife technician for the New York State Department of Environmental Conservation. As part of her MS work, Deanna has been able to participate in the Social Science Subcommittee of the Multistate CWD Research Consortium, which coordinates CWD-related research across multiple disciplines and jurisdictions.

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LIST OF ABBREVIATIONS

CCSS = Center for Conservation Social Sciences (Cornell University)

CWD = Chronic wasting disease

NAT = Norm-activation theory

NSLs = Natural (deer urine-based) scent lures

NY hunters = New York residents licensed to hunt in New York

NYSDEC (or DEC) = New York State Department of Environmental Conservation

PA hunters = New York residents licensed to hunt in Pennsylvania

PGC = Pennsylvania Game Commission

WDNR = Wisconsin Department of Natural Resources

PREFACE

Chronic wasting disease (CWD) is a fatal prion disease that affects deer species (including white-tailed deer). CWD threatens the sustainability of wild deer herds and the many benefits provided to the public, including wildlife viewing and recreational hunting opportunities. Prevention of CWD is a complex challenge involving ecological and human dimensions and their interactions. Certain deer hunting behaviors pose a risk of introducing CWD to new areas, so cooperation from deer hunters is a necessary consideration to successfully prevent the spread of CWD to uninfected areas such as New York (USA) (Gillin & Mawdsley, 2018). Most research on the human dimensions of CWD has focused on hunter responses after a CWD outbreak and little is known about the factors influencing hunter involvement in CWD prevention (arguably the most critical stage of CWD management when prevention is possible).

In this thesis, I present my research on the influence of personal norms on deer hunter performance of two CWD risk-minimizing behaviors: bringing only deboned deer meat or cleaned parts back to New York after hunting elsewhere and hunting deer without using natural scent lures. I use norm-activation theory (NAT) as a conceptual framework to assess personal normative influences on hunters' intentions to perform risk-minimizing behaviors. My findings will help wildlife and disease managers achieve disease prevention objectives by adding to current knowledge about factors determining hunter behaviors and opportunities to encourage hunters to adopt these CWD risk-minimizing behaviors.

The thesis is structured as follows. First, I provide background on the importance of white-tailed deer in North America and details about CWD, its transmission, and efforts to manage it. Then, I give an overview of past research on the human dimensions of CWD, including exploration of hunters' CWD risk perceptions, participation in deer hunting following a CWD discovery, support for CWD management, and performance of CWD risk-minimizing behaviors. Next, I present my study's purpose, conceptual framework, and research objectives. Finally, I describe my study methods and results before discussing the implications of my findings.

INTRODUCTION

White-tailed Deer and Chronic Wasting Disease (CWD)

White-tailed deer are an important species across North America. They are the most popular hunted big game species, with an estimated 70% of all United States (US) hunters pursuing deer in 2016 (U.S. Fish and Wildlife Service & U.S. Census Bureau, 2016). Deer hunting and viewing also support local economies with an estimated annual net economic value of 12.2 billion USD in 2008 (white-tailed and mule deer) (Conover, 2011 as cited in Hewitt, 2015). Deer meat, or venison, is an essential source of protein for many people. Across the 2014-2015 and 2015-2016 license years, deer hunters harvested over 642 million pounds of consumable white-tailed deer meat in the US and over 24 million pounds in Canada (Mahoney, 2020).

Chronic wasting disease (CWD) is a fatal prion disease affecting white-tailed deer and other members of the deer family (cervids), threatening the many benefits they provide. CWD has been detected in wild cervids in 29 states in the US and three provinces in Canada (Richards, 2021). Animals in the late stages of the disease often present a vivid image of suffering with symptoms including dramatic weight loss (giving the appearance that the animal is "wasting away"), listlessness, and drooling (Rivera et al., 2019). There are no known treatments to cure or prevent CWD, which poses a risk to individual wellbeing and sustainability of cervid populations when large portions of the herd are infected (Almberg et al., 2011; Rivera et al., 2019).

There is scientific uncertainty about whether humans can be infected with CWD creating hesitancy about the safety of consuming deer meat in areas where

CWD is present. CWD falls into the same category of transmissible spongiform encephalopathies as mad cow disease (and its human variant, Creutzfeldt-Jakob disease). The example of mad cow disease crossing the species barrier to infect humans contributes to the concern that CWD could also cross into humans (Leiss, 2013). While there have been no known cases of human infection, the potential for transmission is not zero (Saunders et al., 2012). Different studies attempting to infect macaques with CWD have had mixed outcomes. Race et al. (2018) tried to infect cynomolgus macaques with brain homogenates from CWD-infected cervids but did not find evidence of transmission. However, ongoing work reported by Adamowicz et al. (2021) found signs of CWD infection in macaques following ingestion treatments.

Perceived risks related to CWD could degrade the benefits the public derives from deer (Decker et al., 2016; Heberlein & Stedman, 2009). As a result, the proliferation of CWD jeopardizes the ability of natural resource agencies to fulfill their public trust responsibilities. Under public trust thinking, trustees like natural resource agencies are obligated to manage public trust assets like wildlife in a way that provides benefits to beneficiaries while ensuring long-term sustainability (Hare & Blossey, 2014). Increasingly, these responsibilities are understood to include wildlife health considerations which directly affect the quantity and quality of the resource and public perceptions of benefits and risks associated with wildlife (Decker et al., 2016).

CWD Transmission and Management

The infectious agent of CWD is a prion, a misfolded protein whose unique characteristics influence CWD transmission and management. Standard

decontamination methods using heat and mild detergents will kill infectious agents like viruses and bacteria, but prions must be "inactivated" using more rigorous procedures (Gillin & Mawdsley, 2018). Williams et al. (2019) found that bleach at a minimum 40% concentration had to be applied for at least 5 minutes to disinfect a CWD-contaminated stainless-steel surface. In infected animals, prions are concentrated in the central nervous system (e.g., brain, spine) but are also found in skeletal muscle, blood, saliva, feces, and urine (Saunders et al., 2012).

In natural systems, vertical transmission (i.e., doe-to-fawn in utero) contributes to CWD spread, but the primary route is horizontal transmission (Rivera et al., 2019). Horizontal transmission occurs through direct contact of a deer with an infected animal (i.e., animal-to-animal) or infected materials (e.g., contact with saliva) and indirect contact facilitated through the environment (Miller et al., 2004; Rivera et al., 2019). Miller et al. (2004) demonstrated indirect environmental transmission in a study where unexposed deer became infected with CWD after living in a paddock with a CWD-infected deer carcass left to decompose two years prior. Indirect transmission is possible because CWD prions can bind to soil particles and plant leaves (where they remain infectious) and transmit CWD to CWD-susceptible animals upon ingestion (Johnson et al., 2006; Pritzkow et al., 2015; Wyckoff et al., 2016).

Given the ample shedding of prions from infected hosts and the ability of prions to persist in the environment, it is likely that prions accumulate in the environment (Almberg et al., 2011; Zabel & Ortega, 2017). As CWD becomes established in an area, disease modeling warns that growing environmental reservoirs increase the relative role of indirect environmental transmission over time (Almberg et

al., 2011; Otero et al., 2021). Once established, complete eradication of CWD is unlikely. The only case where CWD was eliminated from a free-ranging herd was in New York, USA (Saunders et al., 2012).

CWD was discovered in two captive deer herds in New York in 2005, prompting the establishment of a containment area with a 10-mile radius around the infected herds (New York State Department of Environmental Conservation [NYSDEC], 2018). Two CWD-positive wild deer were discovered during intensive sampling of the containment area and emergency regulations were immediately adopted (including required testing of hunter-harvested deer and disposal of carcasses in the trash or at a landfill) (Brown et al., 2006). Over the next five years, 7,000 wild deer were tested in the containment area and no additional cases of CWD were discovered (NYSDEC, 2018).

It is generally accepted that management aimed at preventing disease introduction is more effective than reactive management after a CWD outbreak (Wobeser, 2002). Methods to limit the introduction of CWD to previously uninfected areas prioritize restricting human movement of live captive cervids, which is considered one of the most significant risks (Gillin & Mawdsley, 2018). Best practices also suggest limiting the movement of hunter-harvested carcasses and limiting the application of natural (deer urine-based) scent lures to surfaces on the landscape while deer hunting. Natural scent lures are largely unregulated, and the products contain urine collected from high-risk captive facilities (Gillin & Mawdsley, 2018).

After a CWD introduction, attempts to control or suppress the disease by maintaining low prevalence levels and limiting its geographic spread are considered

more tenable goals than disease eradication (Saunders et al., 2012). Most attempts to suppress CWD through population management use hunter-harvest or agency culling to achieve objectives such as density reduction and targeted removal of individuals in specific sex and age categories (e.g., adult males) (Gillin & Mawdsley, 2018; Potapov et al., 2016). Studies on the efficacy of hunter-harvest programs have had mixed results. Some studies have found a negative relationship between hunting pressure and CWD prevalence, suggesting harvest may be sufficient to influence CWD prevalence (Conner et al., 2021; Miller et al., 2020). Other studies have cast doubt on the ability of hunter-harvest to control CWD successfully and instead advocate for the efficiency of professional culling programs (Manjerovic et al., 2014; Mysterud et al., 2019).

Effective management of CWD depends on effective strategies and public support for (or at least lack of opposition to) the management approach. The case of CWD in Wisconsin (USA) demonstrates the power of public perceptions to shape the trajectory of CWD. CWD was first discovered in wild deer in 2002. Wisconsin's initial CWD management response was critiqued for largely ignoring the interests of the public and especially of deer hunters (many of whom were opposed to the new CWD firearm season that extended into archery season and the Earn-A-Buck program) (Heberlein, 2004; Holsman et al., 2010). Wisconsin also implemented an agency culling program as part of the initial management response. However, public backlash and a lack of hunter support significantly reduced the culling program in 2007 (Holsman et al., 2010).

The neighboring state of Illinois (USA) also discovered CWD in 2002, and without significant public opposition, the agency culling program remains operational

to this day. A study comparing CWD prevalence levels in Wisconsin and Illinois showed that before Wisconsin ended its culling program (2003-2007), there was no significant difference between the prevalence levels in the two states (Manjerovic et al., 2014). However, after the culling program ended (2008-2012), Wisconsin's annual prevalence levels increased while Illinois had no change in prevalence. Today, some areas of Wisconsin are seeing infection in more than 50% of adult male deer, and preliminary results show infected deer are dying at rates upwards of two times that of uninfected deer (Smith, 2019).

Human Dimensions of CWD

Deer hunters are an important segment of the public affected by the presence (and subsequent management) of CWD and affecting the geographic distribution and management of CWD in several ways. Deer hunters are influential not only through their support for or opposition to CWD management strategies (as demonstrated in the Wisconsin example) but through their deer hunting behaviors and participation. Many natural resource agencies are concerned that CWD could lead to declines in hunting participation (Lyon & Vaske, 2010; Miller, 2004; Needham et al., 2004). Continued hunting participation is vital because deer hunters help to fund conservation and management budgets through license sales and Pittman-Robinson taxes on sporting arms, archery equipment, and ammunition, and contribute to wildlife and habitat management through deer population management (Hewitt, 2015; Lyon & Vaske, 2010; Needham et al., 2006).

If deer hunters can shape the trajectory of CWD, understanding their past responses to CWD and anticipating future responses is essential for achieving wildlife and disease management goals. Most human dimensions of CWD studies have explored deer hunters' perceptions of CWD as a risk, continued participation in hunting following a CWD introduction, and support for CWD management (Holsman et al., 2010; Vaske, 2010). Hunters' risk perceptions, trust in natural resource agencies, and perceptions of the efficacy of CWD management strategies are common factors hypothesized to influence hunter responses after a CWD introduction. Few studies have focused on how hunters respond proactively to prevent the introduction of CWD (the focus of this thesis), but this remains a necessary consideration as CWD prevention is arguably the most critical stage in CWD management.

Hunter Risk Perceptions

CWD poses a risk, conventionally defined as an "exposure to the chance of loss" or exposure to a hazard with the potential to cause harm (Heberlein & Stedman, 2009; Leiss, 1996). Deer hunters generally perceive CWD to pose risks to deer and human health, as well as deer hunting, so how deer hunters make sense of CWD as a risk will likely influence how they respond to it (Heberlein & Stedman, 2009). Risk literature distinguishes between technical risk assessments made by experts and "intuitive risk judgments" or risk perceptions the public relies on (Slovic, 1987). Risk perceptions may be informed by technical considerations, such as the severity of consequences and probability of occurrence, as well as more qualitative or affective (emotional) aspects (McComas, 2006; Slovic, 1987, 1993; Slovic et al., 2004).

In the case of Wisconsin, most hunters had never heard of CWD before it was introduced (as in many other places without CWD), but within two months of the discovery, most hunters (96%) were aware of CWD (Heberlein & Stedman, 2009). The lack of experience with CWD and the time pressure to assess CWD provided the right conditions for risk perceptions to be heavily informed by emotional or affect-based responses rather than more analytical and weighed responses (Heberlein, 2004; Tompkins et al., 2018). Furthermore, hunters were assessing risk in a charged and rapidly changing social context, fueling the social amplification of risk where a risk with a relatively low "assessed risk" in technical terms was associated with disproportionately high-risk perceptions (Heberlein & Stedman, 2009).

Across the US, surveys deployed within a year of a CWD discovery showed that deer hunters varied within a range of moderate risk perceptions, but risk perceptions were generally not amplified to the extent documented in Wisconsin. Across different strata of South Dakota hunters, between 56 and 64% were at least slightly worried about CWD in the state (Gigliotti, 2004). Across different strata of New York hunters, 70-79% of hunters said they were concerned about CWD (Brown et al., 2006). Hunters demonstrated various levels of concern about CWD's human health risks. Of New York hunters, 45% had human health concerns about CWD (Brown et al., 2006). Of Illinois hunters, only 17% believed humans could be infected with CWD after eating contaminated meat (Miller, 2004).

Studies suggest hunters' risk perceptions not only vary between hunters in different states but over time, with hunter CWD risk perceptions appearing to decrease with time since discovery (Holsman et al., 2010; Needham & Vaske, 2006; Pattison-

Williams et al., 2020; Vaske & Miller, 2018). A survey of Colorado hunters was repeated in 2003 and 2004 and found that a larger proportion of hunters in the 2004 survey agreed that the threat of CWD had been exaggerated, and a smaller proportion agreed that CWD posed a risk to humans and should be eliminated (Needham & Vaske, 2006). The percent of Illinois hunters who perceived no risk to humans from CWD nearly doubled from 2004 (26%) to 2012 (51%) (Vaske & Miller, 2018).

CWD risk perceptions may vary according to many factors. Psychometric research on risk perceptions suggests two common factors account for multiple qualitative risk characteristics: "unknown risk" (assessments of how new and known to science a risk is) and "dread risk" (considers how controllable and catastrophic a risk is) (Kasperson et al., 1988; Slovic, 1987). Heberlein and Stedman (2009) suggest the response to CWD in Wisconsin was influenced by comparisons and transposed feelings of dread associated with another prion disease, mad cow disease. In comprehending an unfamiliar risk, risk comparisons involve identifying a similar, more common risk and using those risk perceptions as a guide for responding to the novel risk (Fischhoff, 1995). Mad cow disease had been at the center of risk communication efforts when public health officials attributed the fatal human variant of mad cow disease (Creutzfeldt-Jakob disease) to the consumption of contaminated meat after assuring the public it was safe to eat (Leiss, 2013; McComas, 2006).

Especially in modern times, the "knowability" of many sources of risk (e.g., nuclear power, prions, vaccination design) is increasingly specialized and beyond the reach of non-experts. Social trust, or willingness to rely on an entity with formal responsibility for management, allows natural resource agencies to manage resources

on behalf of the public (Cvetkovich & Winter, 2003; Siegrist et al., 2000). In Wisconsin, deer hunters distrusted WDNR's deer population management even before CWD (Holsman et al., 2010). However, in other places, trust in the responsible natural resource agency could lead to attenuated risk perceptions, especially in conjunction with perceptions that science-based management can mitigate the impacts of CWD (Cooney & Holsman, 2010; Needham & Vaske, 2008; Siegrist et al., 2000).

Hunting Participation

Concerns that CWD would negatively impact hunting participation were substantiated in Wisconsin, where deer license sales decreased by about 10-11% following the discovery of CWD (Heberlein, 2004; Vaske et al., 2004). Of Wisconsin hunters who did not hunt after the CWD discovery (i.e., people who hunted in the 2001 license year but not in the 2002 license year) (n=222), about half claimed their decision to stop hunting was strongly or moderately influenced by their CWD risk perceptions (Vaske et al., 2004). The hunters who stopped hunting because of CWD perceived higher levels of human health risks from CWD than hunters who stopped for other reasons. While this may seem intuitive, it supports the notion that hunting participation could decline due to CWD risk perceptions.

Many other studies did not find evidence of hunting participation declines due to CWD. Several studies reported deer hunters' intentions to continue hunting were largely unchanged at low disease prevalence levels (Brown et al., 2006; Gigliotti, 2004; Miller, 2004; Pattison-Williams et al., 2020). Based on a survey of almost 10,000 hunters from eight different US states, most hunters (98%) said they would

continue hunting in-state if CWD was limited to one zone of the state at a prevalence level of less than 10% (Needham et al., 2006). Several studies suggested the current prevalence and distribution of CWD in most states would have to increase considerably before hunters would not be willing to continue deer hunting (Lyon & Vaske, 2010; Needham et al., 2004; Pattison-Williams et al., 2020).

Even in cases where hunters expressed intentions to stop hunting, recent studies have indicated these intentions do not always align with actual behavior change. In a survey of Maryland, USA hunters who said they had stopped hunting because of CWD, the authors found that about half of these hunters continued to report harvesting deer post-CWD (Haus et al., 2017). Furthermore, the Maryland study found that CWD did not affect hunter-harvest rates at a local level beyond what would be expected from normal stochastic variation, and any temporary declines in hunter-harvest rates have since returned to pre-CWD levels (Haus et al., 2017; Holland et al., 2020). Even in Wisconsin, initial decreases in demand for resident deer hunting permits due to CWD appear to have partially recovered over time, and the influence of the disease on demand has diminished over time (Erickson et al., 2019).

Hunter Support for CWD Management

As demonstrated by the case of CWD in Wisconsin, hunter support for disease management goals and strategies affects CWD outcomes. CWD management goals range from complete disease eradication to disease suppression by limiting the geographic spread and prevalence of the disease in infected areas (Conner et al., 2021). Although preventative actions are considered the best option, reactive

management aimed at limiting a CWD outbreak is generally considered a more tenable goal than complete disease eradication (Bolton, 2019; Saunders et al., 2012). Strategies for CWD suppression primarily focus on population management using hunter-harvest or professional culling programs to remove animals. Still, objectives vary from complete removal of an infected population, general reduction of herd density, or selective removal of infected animals or animals in specific age and sex classes (Gillin & Mawdsley, 2018; Miller et al., 2020; Wobeser, 2002).

Hunter's support for management differs greatly based on the particular management strategy. Hunters consistently support non-lethal methods (including monitoring and surveillance of cervid populations) and consider "no action" to be an unacceptable management response, and are consistently inconsistent in their support for population management or herd reduction goals (Lischka et al., 2010; Meeks et al., 2021; Needham et al., 2004, 2006). Harper et al. (2015) demonstrated a nearly 50-50 split in Illinois hunters' acceptance of an agency culling operation utilizing sharpshooters. Respondents chose only one of two statements, and 52% selected, "I favor ending IDNR sharpshooting with a higher likelihood of CWD spreading to more counties." In contrast, 48% chose, "I favor continuing IDNR sharpshooting to reduce the likelihood of CWD spreading to more counties." Needham et al. (2004, 2006) presented hunters with hypothetical situations that varied disease spread, prevalence, and health implications and found that agency culling operations were controversial even in "worst-case conditions."

Studies measuring the perceived efficacy of management strategies, or perceptions of an action's ability to produce the desired outcome, have consistently

found a positive relationship between hunter support and perceived efficacy of the management approach (Cooney & Holsman, 2010; Holsman et al., 2010; Meeks et al., 2021; Schroeder et al., 2021). Cooney and Holsman (2010) found that the strongest predictor of hunter support for deer herd reduction was the perceived efficacy of the specific reduction strategy, even stronger than beliefs that CWD needed to be eradicated. However, hunters have demonstrated hesitancy about the effectiveness of CWD management strategies. A significant portion of Wisconsin hunters (69%) agreed with the statement, "Even if most of the infected deer are killed, CWD will still persist in the environment," and only 24% of respondents agreed that CWD could be eradicated from the deer herd through management efforts (Holsman et al., 2010).

Hunter Risk-Minimizing Behaviors

Beyond supporting actions taken by natural resource agencies, hunters can support CWD management directly by participating in behaviors that help to reduce the spread and prevalence of CWD. To reduce the chances of introducing CWD to uninfected areas, hunters can transport only deboned meat or cleaned parts of harvested cervid species and hunt deer without using natural scent lures that contain urine collected from captive deer facilities (Gillin & Mawdsley, 2018). To help reduce CWD prevalence, hunters can increase their personal harvest and remove the remainders of processed cervid carcasses from the landscape to prevent further transmission of CWD should an animal be CWD-positive.

It appears to be unlikely that hunters are willing to increase their personal harvest. Holsman and Petchenik (2006) found that the number of deer harvested by

Wisconsin hunters was more dependent on their intrinsic harvest threshold (i.e., the number of deer they were willing to shoot for their own use) than on attitudes toward the agency's eradication plan, deer reduction goal, or perceived risk from eating deer meat. The idea of shooting deer for disease management may conflict with consumption norms to harvest animals for consumption and consume any harvested meat (Holsman et al., 2010; Mysterud et al., 2019).

Research on hunter performance of proactive behaviors that help prevent the further spread of CWD is mainly missing from the human dimensions of CWD literature. However, some ongoing work in New York has focused on avoiding the reintroduction and establishment of CWD in New York following the 2005 outbreak and elimination of the disease. A study of New York deer hunters indicated risk-minimizing behaviors (including hunting deer without using natural scent lures and disposing of deer carcasses in the trash or by taking them to a landfill) varied amongst hunters but had limited success in explaining this variation (Siemer et al., 2020). Despite most hunters believing the spread of CWD in New York would lead to a significant decline in the deer population (71%) and negative impacts on hunting traditions in New York (75%), these beliefs did not predict hunters' intentions to adopt risk-minimizing behaviors. Perceived efficacy of the behaviors in keeping CWD out of New York positively influenced hunter intentions. However, a substantial portion of hunters were unsure about the efficacy of each risk-minimizing behavior: bringing only deboned deer meat or cleaned parts back to New York (25%), avoiding use of natural scent lures (34%), and disposing of carcasses in the trash or landfill (29%), and ultimately perceived efficacy explained relatively little variance in intentions.

As with decisions about personal harvest thresholds, hunter performance of risk-minimizing behaviors also appears to be influenced by norms and values. In focus groups with New York deer hunters, participants mentioned motivations for their CWD-related behaviors, including minimizing animal suffering, treating harvested animals with respect, feelings of obligation to reduce the waste they produce, and preserving deer hunting tradition and opportunities for future deer hunters (Siemer et al., 2021). Although some hunters questioned the efficacy of recommended CWD risk-minimizing behaviors, many maintained a desire to learn what the "right thing" to do was (Siemer et al., 2021). Normative influences have been under-explored as a factor influencing deer hunters.

The Current Study

Study Purpose

The purpose of the current study is to provide a better understanding of factors influencing deer hunters' intentions to perform CWD risk-minimizing behaviors and opportunities to encourage hunters to adopt these behaviors in support of efforts to keep CWD out of New York. Based on indications that moral considerations influence hunting-related behaviors, I use norm-activation theory (NAT) as a framework to understand personal normative influences on deer hunters' behavioral intentions. To my knowledge, this is the first time NAT has been applied in the context of the human dimensions of wildlife management and certainly to behaviors that minimize the risk of spreading CWD.

New York residents who hunt outside of New York, and especially in CWD-positive areas, are of particular interest in efforts to prevent the introduction of CWD to New York. These hunters are at a higher risk of interacting with potentially infectious materials and may have different beliefs and behaviors, given that they hunt in areas where CWD has been found. In this study, I surveyed New York residents licensed to hunt in New York (NY hunters) and New York residents licensed to hunt in the neighboring state of Pennsylvania (PA hunters), where CWD has been found in wild deer. As recently as 2021, the first case of CWD in the northern tier of Pennsylvania (the counties bordering New York) prompted the creation of a new disease management area by Pennsylvania with a northern limit delineated by the New York state border (Pennsylvania Game Commission, 2021).

Conceptual Framework

Norm-activation theory (NAT) was initially applied to altruistic behaviors (e.g., donating blood) but has since been used to predict pro-environmental behaviors or intentions, including acceptance of energy policies (de Groot & Steg, 2009; Steg & de Groot, 2010), willingness to demonstrate against pollution (de Groot & Steg, 2009; Steg & de Groot, 2010), reduce personal car usage (Harland et al., 1999, 2007; Klöckner & Matthies, 2004; Nordlund & Garvill, 2003), volunteer for an environmental organization (Harland et al., 2007), and engage in recycling (Janmaimool, 2017; Minton & Rose, 1997; Vining & Ebreo, 1992).

NAT posits that activated *personal norms*, or "feelings of moral obligation to engage in a certain behavior," influence *behavioral intentions* (Schwartz, 1977).

Personal norms are internalized standards of behavior that are guided by self-expectations and experienced as an "inner voice" (Harland et al., 2007; Schwartz, 1977). Personal norms are predicted to influence intentions because behaving in accordance with one's internalized values is accompanied by positive feelings about oneself (Schwartz, 1977; Schwartz & Howard, 1984).

NAT predicts personal norms are activated when a person is aware of a need or problem that has negative consequences for something of value to them (*problem awareness* and *value relevance*), leading to self-involvement in problem reduction based on feeling responsible and able to help (*personal responsibility*) (de Groot & Steg, 2009; Schwartz, 1977) (Figure 1). Specific beliefs are expected to be more closely related to specific behaviors than general beliefs, and scholars applying NAT have suggested that problem awareness should be evaluated at both a behavior-specific and general level (Nordlund & Garvill, 2003; Steg & de Groot, 2010). For example, hunter perceptions that a specific hunting behavior is problematic should be a better predictor of their intentions to perform (or refrain from) that behavior than general beliefs about CWD being a problem (Nordlund & Garvill, 2003).

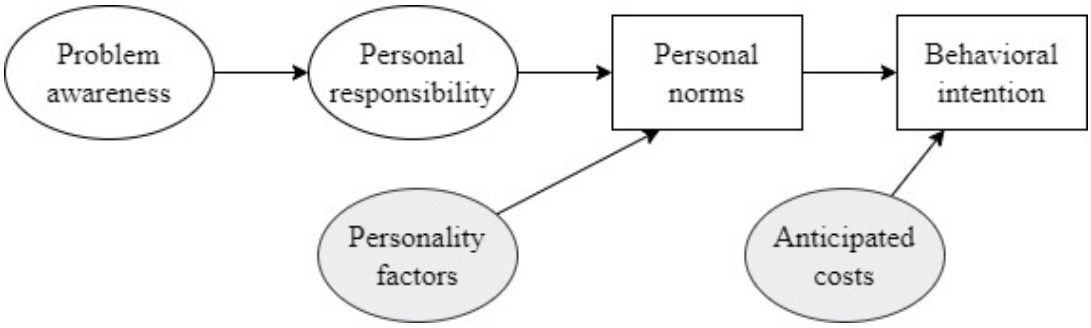

Figure 1. Diagram of Schwartz's (1977) norm-activation theory (NAT).

Outside of the core process of NAT "moving from the initial perception of need through the activation of the normative structure and the generation of feelings of moral obligation to the eventual overt response," Schwartz (1977) suggests *anticipated costs* and personality factors (*awareness of consequences* and *responsibility denial*) can influence norm-activation and an individuals' eventual behavioral intentions. Costs associated with performing the norm-accordant behavior may be physical (e.g., money), moral (e.g., conflict with other personal norms), or social (e.g., conflict with social norms) in nature. Awareness of consequences is a measure of individual propensities to become aware of the external effects of their behavior, and responsibility denial measures an individual's tendency to accept or reject rationales that lower their personal responsibility (Schwartz, 1977; Schwartz & Howard, 1981). Many personal norms studies focus on situational variables (problem awareness and personal responsibility) and often omit personality factors (Harland et al., 2007).

Studies based on NAT have differed not only in the concepts they engage but in their operationalization of concepts, especially personal responsibility (Harland et al., 2007; Steg & de Groot, 2010). Schwartz (1977) described multiple dimensions of the responsibility concept: *ascription of responsibility* (a sense of responsibility to become involved), *efficacy* (identification of effective actions to reduce the problem), and *ability* (perceived personal ability to perform the effective action). Some studies have operationalized the personal responsibility concept as *outcome efficacy*, a combination of efficacy and ability measuring beliefs about one's power to produce the desired outcome (i.e., problem reduction) (Steg & de Groot, 2010).

While outcome efficacy is beneficial when problem reduction requires collective action or contributions from others, it is conceivable that the ascription of responsibility (to oneself) would also be meaningful when there are other potentially responsible parties (Harland et al., 2007; Steg & de Groot, 2010). As outcome efficacy does not account for the ascription of responsibility, it seems problematic to operationalize personal responsibility solely as outcome efficacy. Specifically, in the case of hunters and CWD prevention, it is conceivable that hunters' feelings of responsibility may be impacted by beliefs about the behavior of others, even if they feel personally able to help reduce the problem. For example, Cooney and Holsman (2010 suggest hunters' beliefs that "others are also doing their part" may influence their participation in behaviors to help manage CWD.

Several scholars have noted a divide in interpretations of NAT as a mediation or a moderation model (de Groot & Steg, 2009; de Ruyter & Wetzels, 2000; Steg & Groot, 2010). Although Schwartz (1977) does not explicitly use the term "mediation," the initial presentation of NAT is most closely aligned with a mediation model. It describes a chain of influence through which problem awareness influences personal responsibility, personal responsibility influences personal norms, and personal norms influence behavioral intentions (de Groot & Steg, 2009). Unlike a mediation model, which predicts *how* (i.e., the mechanisms by which) personal norms influence intentions, NAT interpreted as a moderation model focuses on *when* a relationship exists between personal norms and behavioral intentions based on levels of problem awareness and personal responsibility (de Groot & Steg, 2009).

Research Questions

RQ1. Do deer hunters' personal norms influence their intentions to participate in behaviors that minimize the risk of introducing CWD to New York?

The human dimensions of CWD literature suggest that hunters' sense-making of CWD as a problem and their perceptions of their role in CWD management influence their response to CWD. In this study, I am particularly interested in the influence hunters' CWD-related personal norms have on their intentions to engage in CWD prevention by performing CWD risk-minimizing behaviors. Based on NAT, I predict hunters' personal norms to perform risk-minimizing behaviors will positively affect their respective behavioral intentions (**Hypothesis 1**).

RQ2. What factors influence activation of deer hunters' personal norms to perform CWD risk-minimizing behaviors?

If my findings suggest personal norms influence hunters' intentions, I will explore the variables and mechanisms influencing personal norm activation. Based on NAT, I predict that problem awareness and personal responsibility will influence personal norms, but based on interpreting NAT as a mediation model, I expect only personal responsibility will directly affect personal norms (**Hypothesis 2**).

RQ3. Do NY hunters and PA hunters differ in their CWD-related beliefs and behaviors?

Pennsylvania is managing a CWD outbreak, while New York is considered CWD-free. New York residents licensed to hunt in Pennsylvania (PA hunters) and

New York residents licensed to hunt in New York (NY hunters) may differ in their CWD-related beliefs and behaviors, given the presence or absence of CWD in the areas where they hunt. PA hunters would have to invest additional resources to travel to another state to hunt and purchase an out-of-state hunting license (more expensive than an in-state hunting license). On average, I predict PA hunters will be more avid deer hunters and consider deer hunting higher personal importance than NY hunters (**Hypothesis 3.1**). I would expect PA hunters to be more familiar with CWD, given the presence of CWD in Pennsylvania, and I predict PA hunters will have lower problem awareness than NY hunters (**Hypothesis 3.2**).

METHODS

Sampling

My research focused on two populations of adult (18 years or older) New York residents: 1) deer hunters licensed to hunt in New York ("NY hunters") and 2) New York residents licensed to hunt in Pennsylvania ("PA hunters"). The New York State Department of Environmental Conservation (NYSDEC) drew an initial random sample of 4,000 hunters from the New York hunting license database for the current 2021-2022 license year ("NY sample"). The Pennsylvania Game Commission drew a random sample of 2,986 New York residents from the Pennsylvania hunting license database for the 2020-2021 license year ("PA sample") based on home zip code. A limitation of using the current license year (when the survey was implemented) to identify PA hunters was that some hunters had not yet bought their licenses for the season and, therefore, were not included in our sample. However, about two-thirds of the total projected licenses had been sold at the time when the sample was drawn.

Hunters who had recently been contacted to participate in other studies or had invalid contact information were removed before drawing a final random sample of 2,000 hunters from each pool. The New York database had email addresses listed for 38% of the hunters, and the other 62% only listed mailing addresses. I maintained the same proportion of hunters with email addresses (38%, n=760) in my final NY sample to preserve an equal likelihood of hunters with email addresses being included in the survey sample.

Data Collection

Data were collected using mail and online surveys. Hunters from the NY sample who had provided an email address received invitation emails to complete the online survey using the Qualtrics platform. Hunters from the NY sample without email addresses and all hunters from the PA sample received the mail questionnaire. All potential study participants were contacted up to 4 times between October and November 2021 following a modified version of the process outlined by Dillman et al. (2014). The first and third communication for the mail survey included a personalized cover letter and a questionnaire with postage pre-paid. The mail survey instrument was comprised of two letter-sized sheets inside a cover and folded in half into a booklet (a total of four pages printed front and back with 5-½ x 8-½ dimensions). The second and fourth contacts included only a personalized cover letter encouraging recipients to return their completed questionnaire. All four waves of the online survey had a personalized email and a link to complete the online survey questionnaire.

Staff at the Center for Conservation Social Sciences (Department of Natural Resources and the Environment, Cornell University, USA) completed 51 follow-up telephone interviews with nonrespondents from the NY sample and 49 from the PA sample. Staff drew a random sample of 200 non-respondents from the NY sample and 200 from the PA sample and attempted to contact each person up to three times. We stopped calling when 50 interviews had been reached from each sample. If the desired number of interviews was not reached with the initial subsample, we drew an additional random sample of 100 non-respondents. We completed 51 interviews with nonrespondents from the NY sample and 49 with nonrespondents from the PA sample.

Measurement

The questionnaire measured general hunting characteristics and sociodemographic variables, CWD-related hunting behaviors, and norm-activation theory (NAT) variables associated with CWD and its prevention. I measured NAT concepts, including value relevance, problem awareness, personal responsibility, personal norms, behavioral intention, and anticipated costs (Figure 1). I focused on two risk-minimizing behaviors NYSDEC encourages deer hunters to adopt: 1) hunting deer without using natural (deer urine-based) scent lures (NSLs), and 2) complying with the 2019 carcass import ban by bringing back only the deboned meat or cleaned parts of a cervid harvested outside of New York. The questionnaire sent to the NY sample ("NY version") was slightly different than the questionnaire sent to the PA sample ("PA version"). Specific differences are noted in the respective sections.

Sociodemographic Characteristics and Past Hunting Behavior

I measured basic demographic variables, including education, age, gender, political views, and participation in past New York and Pennsylvania hunting seasons using items from Siemer et al. (2020). To measure hunting participation, I asked, "Over the last 5 years, about how many days per year did you typically hunt during the following seasons" with responses including "None," "1-2" days, "3-7" days, and "8+" days. I also asked, "About how many total years have you hunted deer?" Based on items from Siemer et al. (2020; 2021), I measured past performance of CWD-related behaviors asking, "Over the past 5 years, how many different years have you done the following in NY?" followed by behaviors including: "Used a natural (deer

urine-based) scent lure" and "Disposed of my deer carcass by putting it in the trash or taking it to a landfill." I also asked about past actions hunting in locations other than New York including how often hunters had: "Harvested a [*cervid species*]" and "Brought the harvested animal back to NY to process." As noted, the PA version specifically asked about hunting deer or elk in PA, whereas the NY version broadly asked about hunting cervid species (deer, elk, moose, or caribou) outside of NY.

Operationalizing Norm-Activation Theory Variables

NAT posits that awareness of negative consequences for something of personal value (problem awareness and value relevance) and self-involvement in helping to reduce the problem (personal responsibility) activate feelings of moral obligation (personal norms) (Schwartz, 1977). Personality factors such as individual tendencies to be aware of consequences of one's behavior (awareness of consequences) and to accept or reject rationales that reduce personal responsibility (responsibility denial) are predicted to contribute to variation in personal norm activation between individuals (Harland et al., 2007; Schwartz, 1977). Activated personal norms are hypothesized to influence behavioral intentions, but to a diminished extent if the individual associates the behavior with substantial costs.

Value relevance: I operationalize value relevance as the extent to which hunters' internalized values and norms are involved in anticipated consequences of a CWD introduction and failure to perform CWD risk-minimizing behaviors. Value relevance was measured by asking hunters to what extent they agreed with the statements: "It is important to me to be an ethical deer hunter," "The health of the NY

deer herd is an important issue to me," and "I think putting effort into keeping CWD out of NY is part of being an ethical hunter." Agreement was rated on a 5-point Likert scale from "strongly disagree" (1) to "strongly agree" (5). I also asked, "How important is deer hunting to you personally?" on a scale from "not at all important" (1) to "very important" (4).

Problem awareness: Problem awareness describes an awareness of impending negative consequences for something of value. In this study, problem awareness measures the extent to which hunters perceive CWD and specific hunting behaviors as problems. More specifically, problem awareness was operationalized at a broad level as beliefs that CWD would have negative consequences (i.e., a dimension of CWD risk perceptions). CWD problem awareness was measured with five items inspired by Harland et al.'s (2007) study on personal normative influences on intentions to volunteer for an environmental agency. The question followed the format: "To what extent would CWD be a problem for…" followed by statements such as "The health of deer throughout NY." Responses were rated on a 4-point Likert scale from "not at all" (1) to "a great extent" (4). Another dimension of CWD risk perceptions, perceived likelihood of the problem occurring, was measured with an item derived from Siemer et al. (2020), "How unlikely or likely do you think it is that CWD will spread to NY in the next 5 years?" rated on a scale from "very unlikely" (1) to "very likely" (5).

I also measured behavior-specific problem awareness, assessing the extent to which hunters thought specific hunting behaviors contributed to the problem by posing a risk of introducing CWD to NY. These questions were inspired by Nordlund and Garvill's (2003) study of specific problem awareness related to personal car usage. My

questions following the format: “To what degree do you believe the following actions pose a risk of introducing CWD?” and followed by actions such as “Using natural scent lures” and “Bringing whole carcasses back to NY after hunting outside of NY (*NY version*) / in PA (*PA version*).” Responses were rated on a 4-point Likert scale from “no risk” (1) to “a great deal of risk” (4).

Personal responsibility: Personal responsibility describes hunters’ sense of responsibility or self-involvement with CWD prevention based on being personally able to (efficacy) and responsible for (ascription of responsibility) helping to reduce the problem by preventing CWD. I measured broad personal responsibility to engage in CWD prevention, or prevention personal responsibility, with the following statements: “There are actions hunters can take to help control the spread of CWD,” “My participation in CWD prevention helps keep CWD out of NY,” “I am partially responsible for preventing a CWD introduction to NY,” and “If I did not put effort into keeping CWD out of NY, I would feel like I was endangering the NY deer hunting experience.” Agreement was rated on a scale from “strongly disagree” (1) to “strongly agree” (5). I also measured hunter attribution of responsibility to hunters, captive deer owners, and NYSDEC managers based on Kluever and Green's (1998) Responsibility Scale. I asked, “To what degree do you believe the following people are responsible for helping to prevent a CWD introduction to NY?” and responses were rated on a scale from “not at all responsible” (1) to “very responsible” (4).

I measured behavior-specific aspects of personal responsibility using items inspired by Harland et al. (2007). I measured the perceived efficacy of the risk-minimizing behaviors using the following statements: “Hunting deer without using

natural scent lures helps to keep CWD out of NY" and "Bringing only deboned meat or cleaned parts back to NY after hunting outside of NY (*NY version*) / in PA (*PA version*) helps to keep CWD out of NY." Both questions were rated on a 5-point Likert scale from "strongly disagree" (1) to "strongly agree" (5). I asked hunters to assess their ability to perform the risk-minimizing behaviors with the questions: "How difficult would it be for you to hunt deer without using natural scent lures?" and "How difficult would it be for you to bring only deboned meat or cleaned parts back to NY after hunting outside of NY (*NY version*) / in PA (*PA version*)?" rated on a 5-point Likert scale from "very easy" (1) to "very difficult" (5).

Personal norms: Personal norms measured to what extent hunters felt morally obliged to engage in (or refrain from) certain behaviors. I measured personal norms using a format combining elements from Schwartz (1977), Schwartz and Howard (1984), and Harland et al. (2007). I measured obligations to engage in CWD prevention at a broad level using the following statements: "I feel a strong moral obligation to help prevent an introduction of CWD to NY" and "I feel a strong moral obligation to ensure that I do not personally introduce CWD to NY." I measured hunters' feelings of obligation to perform the risk-minimizing behaviors with the items: "I feel a strong moral obligation to hunt deer without using natural scent lures" and "If I hunt outside NY, I feel a strong moral obligation to bring only deboned meat or cleaned parts back to NY" (*NY version*) or "I feel a strong moral obligation to bring only deboned meat or cleaned parts back to NY after hunting in PA" (*PA version*). All items were assessed on a scale from "strongly disagree" (1) to "strongly agree" (5).

Behavioral intentions: Behavioral intentions were measured by asking participants: “To what extent do you agree that you plan to take the following actions within the next 3 years?” followed by actions including the two risk-minimizing behaviors: “Never use natural scent lures to hunt deer” and “If I hunt outside NY, bring only deboned meat or cleaned parts back to NY” (*NY version*) / “Bring only deboned meat or cleaned parts back to NY after hunting in PA” (*PA version*). Responses ranged from “strongly disagree” (1) to “strongly agree” (5).

Anticipated costs: According to NAT, after activation of personal norms, the individual may anticipate substantial costs to performing the norm-accordant behavior. Anticipated costs may be physical, moral, or social in nature. I measured social expectations or norms roughly based on items from Klöckner and Matthies' (2004) study on travel mode choices. The items began with the prompt: “The people who matter most to me think I should…” followed by a statement such as “Hunt deer without using natural scent lures” and “Bring only deboned meat or cleaned parts back to NY after hunting outside of NY (*NY version*) / in PA (*PA version*).” These statements were assessed on a 5-point Likert scale from “strongly disagree” (1) to “strongly agree” (5). On the NY version of the questionnaire, I also asked, “How much do you think hunting deer without using natural scent lures would affect your deer harvest success?” with responses on a 4-point scale from “not at all” (1) to “a great deal” (4). Due to space limitations on the survey instrument, I could not include this question in the PA version of the questionnaire.

Personality factors: I engaged the awareness of consequences concept by asking to what extent participants agreed with the statement: “I think my current deer

hunting behaviors impact future deer hunters," rated on a 5-point Likert scale from "strongly disagree" (1) to "strongly agree" (5). I measured responsibility denial on the same scale based on agreement with the statement: "If other hunters do not participate in CWD prevention, I will feel less responsible to do so."

Data Analysis

Data were analyzed using SPSS Version 28. I used *t*-tests to compare means across groups: nonrespondents and respondents, deer hunters licensed to hunt in New York (NY hunters), and NY residents licensed to hunt in Pennsylvania (PA hunters). I report two-sided probabilities for *t*-tests and Cohen's *d* to measure effect size.

I used exploratory factor analysis (EFA) to explore the underlying structure of associations between items measuring complex concepts (Fabrigar & Wegener, 2011). I concluded the extent of the relationships within the data were sufficient to run an EFA if Bartlett's Test of Sphericity was significant (indicating the presence of relationships within the data) and the Kaiser-Meyer-Olkin measure was greater than or equal to .70 (indicating the common variance is above an acceptable level) (Howard, 2016; Watkins, 2018). I ran EFA using principal axis factoring (PAF) as recommended in cases where multivariate normality is violated (Costello & Osborne, 2005). I used syntax from O'Connor (2000) to compute eigenvalues from the reduced correlation matrix, which are more appropriate for PAF than the default eigenvalues reported from the unreduced matrix (Fabrigar & Wegener, 2011).

I determined the number of factors to retain using a combination of theoretical reasoning, visual scree plot analyses, and parallel analyses (the latter using additional

syntax in SPSS) (Goretzko et al., 2021; Howard, 2016; O'Connor, 2000; Russell, 2002; Watkins, 2018). Where applicable, I used a Promax oblique rotation, and I used a factor loading cutoff of | 0.50 | to identify items that loaded satisfactorily onto a factor (a factor loading ≥ 0.50 is considered a "strong" loading) (Costello & Osborne, 2005). Ultimately, I used a combination of statistical results and theoretical considerations to decide which variables and factors to use in scale creation. I assessed the reliability or internal consistency of multi-item scales using Cronbach's alpha and created composite scales by averaging scores on the included items.

To explain variation in hunters' behavioral intentions, I used linear regression models, including hunters' personal norms to perform risk-minimizing behaviors. Believing personal norms are useful in understanding behavioral intentions, I used logistic regression to predict the likelihood of personal norms being activated using norm-activation theory (NAT) concepts. I determined the significance of predictors at the 0.05 level and used the R^2 value to assess the overall model fit for linear regression and the Nagelkerke R^2 value for logistic regression.

Using the PROCESS macro in SPSS, I performed mediation analyses to assess the indirect effect of independent variables on dependent variables as conveyed by intervening variables or mediators (Hayes, 2012; Preacher & Hayes, 2004). A 95% confidence interval for the indirect effect size was estimated using bootstrapping with 5000 iterations of random resampling of cases in the raw dataset (Hayes & Rockwood, 2017). The null hypothesis (that the indirect effect equaled zero) was rejected if the 95% confidence interval estimate did not include zero (Hayes & Rockwood, 2017).

RESULTS

The response rate for the NY sample was 22.0% (n=407) and 35.0% for the PA sample (n=688). Within the NY sample, the mail survey had a response rate of 23.7% (n=272), and the online survey had a response rate of 19.1% (n=135). Survey questions were only relevant to members of the sample who hunt deer or other cervids, so the reported analyses include only participants who had hunted a cervid species (inside or outside of New York) at least once in the last five years (381 NY respondents and 677 PA respondents).

Comparing Nonrespondents and Respondents

Nonrespondent interviews included a small subset of questions from the complete survey questionnaire (11 questions for NY nonrespondents and 10 for PA nonrespondents). Questions were selected based on their potential to distinguish between survey respondents and nonrespondents based on hunter characteristics in each sample. Comparisons of NY nonrespondents and NY respondents and PA nonrespondents and PA respondents are reported separately. I used independent samples *t*-tests to compare nonrespondents and respondents on norm-activation theory variables, past hunting behaviors, and intentions.

NY Nonrespondents and NY Respondents

NY nonrespondents and NY respondents differed in several ways. NY nonrespondents were younger ($\bar{x}$=47.5 years) than NY respondents ($\bar{x}$=57.2 years)

(p<.001) (Table 1). NY nonrespondents had typically hunted fewer days in the regular NY deer season ($\bar{x}$=3.16) compared to respondents ($\bar{x}$=3.47) (p=.035). Despite hunting fewer days in the regular season, NY nonrespondents had harvested deer in NY in more years ($\bar{x}$=3.45) than respondents ($\bar{x}$=2.76) (p=.012) and had used natural scent lures in more years ($\bar{x}$=2.29) than respondents ($\bar{x}$=1.50) (p<.007). NY nonrespondents also believed using natural scent lures posed less of a risk of introducing CWD to NY ($\bar{x}$=1.57) than respondents ($\bar{x}$=2.05) (p=.004). Finally, NY nonrespondents agreed to a lesser degree ($\bar{x}$=3.39) than respondents ($\bar{x}$=3.94) (p=.002) with the statement, "I am partially responsible for preventing a CWD introduction to NY."

Table 1. Differences between NY nonrespondents and NY respondents.

	NY Non-Respondents	NY Respondents	Independent Samples Test		
	$\bar{x}$ (SD)	$\bar{x}$ (SD)	t	p	Cohen's d
Age	47.5 (17.0)	57.2 (15.7)	-4.08	<.001	-0.61
Typical days hunting in NY regular season[1]	3.16 (1.01)	3.47 (0.73)	-2.16	.035	-0.41
Years harvesting deer in NY	3.45 (1.94)	2.76 (1.83)	2.52	.012	0.38
Years using natural scent lures	2.29 (2.04)	1.50 (1.94)	2.70	.007	0.40
NSL problem awareness[2]	1.57 (0.93)	2.05 (0.96)	-2.92	.004	-0.51
Feel partially responsible for preventing CWD[3]	3.39 (1.27)	3.94 (1.12)	-3.16	.002	-0.48

[1]Measured on a scale from no days (1), 1-2 days (2), 3-7 days (3), to 8+ days (4).
[2]Measured on a scale from "no risk" (1) to "a great deal of risk" (4).
[3]Measured on a scale from "strongly disagree" (1) to "strongly agree" (5).

NY nonrespondents and respondents did not differ in the extent to which deer hunting was personally important to them, nor in the rate at which they had participated in NY archery seasons or had hunted cervids outside of NY. They also did not significantly differ in their perceived likelihood of a CWD introduction to NY in the next five years.

PA Nonrespondents and PA Respondents

Like nonrespondents from NY, PA nonrespondents were significantly younger ($\bar{x}$=43.6 years) than PA respondents ($\bar{x}$=57.3 years) (p<.001) and had used natural scent lures in more years ($\bar{x}$=2.10) than respondents ($\bar{x}$=1.44) (p=.011) (Table 2). PA nonrespondents typically hunted fewer days in the regular New York deer season ($\bar{x}$=2.69) than PA respondents ($\bar{x}$=3.21) (p=.004). Over the past five years, PA nonrespondents had harvested deer or elk in Pennsylvania in more years ($\bar{x}$=3.02) than respondents ($\bar{x}$=2.06) (p=.004) and believed bringing a whole carcass back to NY posed less of a risk of introducing CWD to NY ($\bar{x}$=2.27) than respondents ($\bar{x}$=2.95) (p<.001). PA nonrespondents and PA respondents did not significantly differ in the rate at which they had hunted during the archery season or the firearms seasons in Pennsylvania, and they felt a similar level of responsibility for preventing the introduction of CWD to New York.

Table 2. Differences between PA nonrespondents and PA respondents.

	PA Non-Respondents	PA Respondents	Independent Samples Test		
	$\bar{x}$ (SD)	$\bar{x}$ (SD)	*t*	*p*	Cohen's *d*
Age	43.6 (15.0)	57.3 (15.0)	-6.18	<.001	-0.91
Typical days hunting in NY regular season[1]	2.69 (1.18)	3.21 (1.02)	-3.02	.004	-0.51
Years harvesting deer/elk in PA	3.02 (2.13)	2.06 (1.85)	3.04	.004	0.51
Years using natural scent lures	2.10 (1.65)	1.44 (1.98)	2.64	.011	0.34
Carcass problem awareness[2]	2.27 (1.15)	2.95 (1.05)	-4.09	<.001	-0.64

[1]Measured on a scale from no days (1), 1-2 days (2), 3-7 days (3), to 8+ days (4).
[2]Measured on a scale from "no risk" (1) to "a great deal of risk" (4).

In sum, NY nonrespondents and PA nonrespondents appeared to be younger and possibly less avid deer hunters (based on time spent in the field) than respondents. Yet, nonrespondents in both samples used natural scent lures at a higher frequency and harvested deer at a higher rate. Nonrespondents also gave the impression that they may be less concerned about their behaviors introducing CWD and NY nonrespondents seemed to feel less responsible for acting to keep CWD out of New York than NY respondents.

Despite observing differences between nonrespondents and respondents, I decided against weighting my survey data based on nonrespondent interviews. Instead, I choose to meaningfully engage with the topic of representativeness and consider the implications of nonresponse bias in the discussion section of this thesis (Stedman et al., 2019). Here, I outline my rationale for not weighting my data. According to Dey

(1997), weights are assigned based on the inverse of the estimated probability of response, giving greater weight to responses most resembling nonrespondents "to compensate for errors in survey coverage." Interviewing nonrespondents allowed me to surmise some ways in which survey respondents and nonrespondents may differ (i.e., nonrespondents seem to be less invested in deer hunting and less concerned that their behaviors will introduce CWD). However, this study is based on a novel application of theory, and I could not say which survey respondents resemble nonrespondents on concepts of interest.

Exploratory Factor Analysis and Scale Creation

I performed exploratory factor analysis (EFA) to assess the factor structure of multi-item concepts, including value relevance, problem awareness, and personal responsibility. Bartlett's test and the KMO values indicated each set of measures contained sufficient common variance to be factorable, so I proceeded with the EFAs. The analyses informing factor retention decisions are available in Appendix A. I created scales to represent the concepts by calculating the average score on included items. I performed the EFAs on the NY and PA samples separately, but to maintain my ability to compare the samples, I only included items in a scale if appropriate for both samples.

Value relevance: Four items were used to measure value relevance or the extent to which consequences of CWD and failure to perform CWD risk-minimizing behaviors would involve hunters' values. The first item asked how important deer hunting was to them personally, and the remaining three items asked to what degree

hunters agreed: the health of the deer herd is an important issue to them, being an ethical hunter is important to them, and helping to prevent CWD is part of being an ethical hunter. The EFA for value relevance indicated only one factor should be retained (Table 14, Appendix A). The last three items loaded satisfactorily on the factor (factor loading ≥ 0.50) for both samples (Table 3).

Table 3. Factor loadings for items measuring value relevance.

	Factor Loadings	
	NY Sample	PA Sample
Personal importance of deer hunting	0.14	0.10
Importance of being an ethical deer hunter	0.75	0.76
Importance of NY deer herd health	0.86	0.82
Believe preventing CWD is part of being an ethical hunter	0.80	0.64

Problem awareness: Problem awareness measured hunters' perceptions that CWD and specific hunting behaviors would have negative consequences for something of value to them. For both samples, the EFA suggested a two-factor solution (Table 14, Appendix A). The items assessing to what degree CWD would be a problem all loaded onto Factor 1 satisfactorily (Table 4). The item assessing the perceived likelihood of CWD becoming a problem (i.e., likelihood of an introduction) did not load onto either factor and was included in the remaining analyses independently. The items measuring hunter beliefs about the risk posed by specific hunting behaviors of introducing CWD, i.e., behavior-specific problem awareness, loaded onto Factor 2.

Table 4. Rotated factor loadings for items measuring problem awareness.

	Factor Loadings			
	NY Sample		PA Sample	
	Factor 1	Factor 2	Factor 1	Factor 2
CWD would be a problem for:				
The health of deer in areas where I hunt in NY	0.88	0.01	0.86	-0.03
The health of deer throughout NY	0.85	0.07	0.92	-0.02
NY deer population levels	0.82	0.00	0.89	-0.04
My deer hunting satisfaction in NY	0.94	-0.17	0.82	-0.01
My willingness to consume venison	0.60	0.05	0.52	0.14
Perceived likelihood of CWD spreading to NY	0.37	0.16	0.19	0.16
Hunting behaviors that could pose some degree risk of introducing CWD to NY:				
Using natural scent lures	0.07	0.43	0.20	0.33
Hunting outside of NY	-0.06	0.74	-0.09	0.82
Hunting in an area where CWD has been found	0.02	0.73	0.00	0.59
Bringing whole carcasses back to NY	0.18	0.55	0.29	0.40
Importing finished taxidermy mounts	-0.08	0.41	0.00	0.28

Personal responsibility: Personal responsibility measured hunters' perceptions of being responsible for and able to help prevent a CWD introduction. The EFAs for both samples suggested one factor should be retained (Table 14, Appendix A). All items measuring perceived ability to and responsibility to generally help prevent CWD strongly loaded onto the factor, as did the perceived efficacy of complying with the carcass import ban (Table 5). Measures of the responsibility attributed to hunters for helping to prevent CWD and perceived efficacy of hunting without using natural scent

lures (NSLs) loaded onto the factor with moderate strength. The items measuring perceived ability to perform risk-minimizing behaviors did not load onto the factor satisfactorily. The weak factor loading indicated these items were manifestations of a different underlying concept and prompted me to interpret the items as measures of perceived costs instead of ability.

Table 5. Factor loadings for items measuring personal responsibility.

	Factor Loading	
	NY Sample	PA Sample
Attribute some degree of responsibility to hunters for helping to prevent CWD	0.46	0.59
Identify effective actions hunters can take to help prevent CWD	0.74	0.72
Feel partially responsible for preventing CWD	0.77	0.74
Believe personal participation in CWD prevention is helpful	0.88	0.87
Feel as if endangering the NY deer hunting experience if no effort put into CWD prevention	0.74	0.82
Efficacy of avoiding NSLs	0.60	0.45
Efficacy of complying with carcass import ban	0.61	0.73
Ability to avoid NSLs (*Reverse coded*)	0.17	0.18
Ability to comply with carcass import ban (*Reverse coded*)	0.03	0.41

Scale Creation

The value relevance scale was created using three items, and composite scores were calculated by averaging the three items (NY sample Cronbach's alpha=0.83, PA sample Cronbach's alpha=0.75) (Table 6). There was little variation in scores on the

value relevance scale, which I interpreted as evidence that CWD and CWD prevention widely involve things of value to respondents (Figure 2). The value relevance scale was not useful in differentiating between hunters, so I did not include the value relevance scale in the remaining analyses.

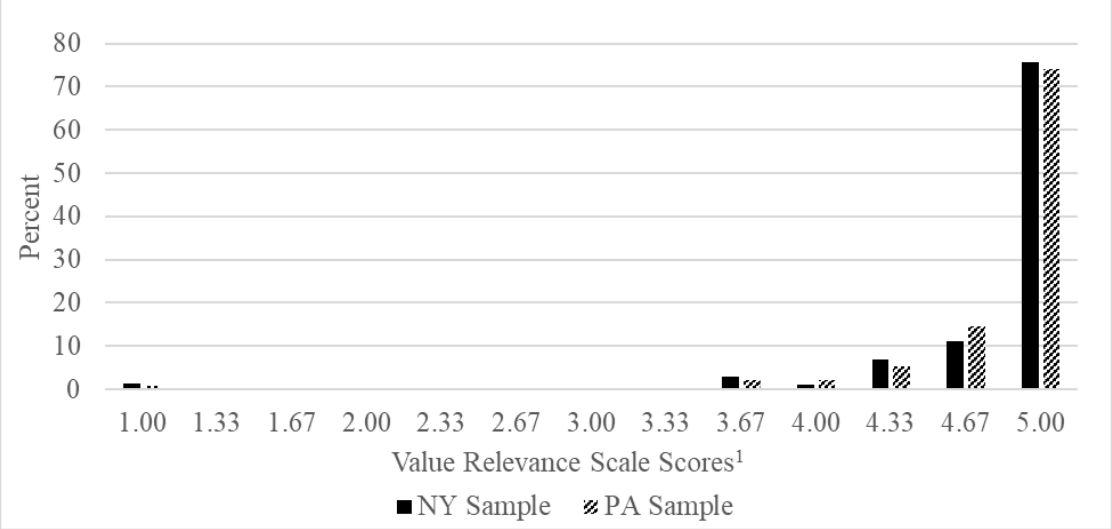

Figure 2. Distribution of scores on value relevance scale.

[1]Composite score based on an average of three items all measured on a scale from "strongly disagree" (1) to "strongly agree" (5).

I created a scale representing hunters' CWD problem awareness using the five items that loaded onto Factor 1 and measured to what extent hunters thought CWD would be a problem (e.g., for NY deer health) (NY sample Cronbach's alpha=0.90, PA sample Cronbach's alpha=0.89) (Table 6). A different common factor accounted for hunters' behavior-specific problem awareness or perceptions that specific hunting behaviors contributed to the problem (by posing a risk of introducing CWD), so I chose to include these items independently in the remaining analyses.

Table 6. Scale creation and reliability analysis for value relevance, problem awareness, and personal responsibility concepts.

	Cronbach's Alpha if Item Deleted	
	NY Sample	PA Sample
Value Relevance Scale:		
Importance of being an ethical deer hunter	0.79	0.65
Importance of NY deer herd health	0.73	0.62
Believe preventing CWD is part of being an ethical hunter	0.77	0.77
Cronbach's Alpha	0.83	0.75
CWD Problem Awareness Scale		
(CWD would be a problem for…)		
The health of deer in areas where I hunt in NY	0.86	0.86
The health of deer throughout NY	0.86	0.85
NY deer population levels	0.87	0.85
My deer hunting satisfaction in NY	0.86	0.85
My willingness to consume venison	0.92	0.92
Cronbach's Alpha	0.90	0.89
Prevention Personal Responsibility Scale:		
Identify effective actions hunters can take to help prevent CWD	0.82	0.87
Feel partially responsible for preventing CWD	0.76	0.85
Believe personal participation in CWD prevention is helpful	0.73	0.80
Feel as if endangering the NY deer hunting experience if no effort put into CWD prevention	0.76	0.84
Cronbach's Alpha	0.82	0.88

The items with the highest factor loadings in the personal responsibility EFA were measures of self-involvement in CWD prevention at a broad level. As a result, I used four items to create a prevention personal responsibility scale reflecting hunter perceptions of responsibility and ability to help prevent CWD (NY sample Cronbach's alpha=0.82, PA sample Cronbach's alpha=0.88) (Table 6). I did not include behavior-specific efficacy items in the scale (despite satisfactory factor loadings). I chose to keep the items independent to maintain my ability to differentiate between the influence of personal responsibility felt at a broad and behavior-specific level. The measures of perceived ability did not load onto the same factor and were included independently in the remaining analyses.

Personal Normative Influences on Deer Hunter Behavioral Intentions

The first CWD risk-minimizing behavior I studied was complying with the carcass import ban by bringing only deboned meat or cleaned parts back to New York after harvesting a cervid outside New York (as required by the 2019 ban on importation of whole cervid carcasses). Few respondents from the NY sample had hunted out of state in the past five years (n=55), so the carcass import behavior did not apply to most NY hunters. I focused my analyses of this behavior on PA hunters who could inadvertently introduce CWD to New York if they returned home to New York with a whole carcass containing CWD-positive materials. The second risk-minimizing behavior I addressed is a NYSDEC recommendation to hunt deer without using natural scent lures (NSLs). I performed analyses for the behavior to avoid NSLs with the NY and PA sample and report results separately.

NAT hypothesizes activated personal norms will influence behavioral intentions, but to a lesser extent, if behaving in accordance with the personal norm is anticipated to have substantial costs (Schwartz, 1977). To test Hypothesis 1 that hunters' personal norm will positively influence their behavior intentions, I regressed intentions to perform risk-minimizing behaviors on personal norms to perform the risk-minimizing behavior, past performance of the "risky" alternate form of the behavior (e.g., bringing whole carcasses back to New York, using natural scent lures [NSLs]), and anticipated costs of performing the behavior. With these models, I was able to explain 46% of the variance in PA hunters' intentions to comply with the import ban, 60% of the variance in NY hunters' intentions to hunt without NSLs, and 64% of the variance in PA hunters' intentions to hunt without NSLs (Table 7).

Some patterns emerged across all models. Hunters' intentions increased with the respective personal norms to comply with the import ban (b=0.35, p<.001) and hunt without using NSLs in both NY hunters (b=0.47, p<.001) and PA hunters (b=0.42; p<.001) (Table 7). Hunters' intentions decreased with past years bringing whole carcasses back to New York (b=-0.19, p<.001) and using NSLs to hunt deer amongst NY hunters (b=-0.16, p<.001) and PA hunters (b=-0.12, p<.001). Finally, perceived efficacy of avoiding NSLs (to help keep CWD out of New York) positively affected intentions to avoid NSLs in NY hunters (b=0.18, p=.001) and PA hunters (b=0.22, p<.001). However, beliefs about the efficacy of complying with the carcass import ban did not predict the respective intentions (p=0.828).

Table 7. Predicting intentions to perform risk-minimizing behaviors using personal norms, anticipated costs, and previously significant variables.

Independent Variables	Intentions								
	Comply with Import Ban (PA Sample)			Hunt Without Using Natural Scent Lures (NSLs) (NY Sample)			(PA Sample)		
	b	SE	Sig.	*b*	SE	Sig.	*b*	SE	Sig.
(Constant)	2.89	0.16	<.001	1.75	0.25	<.001	1.17	0.16	<.001
Personal norms to perform risk-minimizing behavior	0.35	0.04	<.001	0.47	0.06	<.001	0.42	0.05	<.001
Years performing the "risky" form of the behavior	-0.19	0.04	<.001	-0.16	0.03	<.001	-0.12	0.02	<.001
Behavior-specific efficacy	0.01	0.04	.828	0.18	0.06	.001	0.22	0.04	<.001
Difficulty of performing the behavior	-0.10	0.02	<.001	-0.09	0.06	.128	-0.12	0.04	.001
Social norm to perform the behavior	0.10	0.04	.016	0.08	0.06	.217	0.20	0.04	<.001
Belief avoiding NSLs would affect harvest success (*NY version only*)				-0.17	0.08	.035			
R^2	0.458			0.604			0.642		
Adj. R^2	0.453			0.596			0.639		
df (residual)	576			298			570		
F	97.242			75.640			204.482		
Sig.	<.001			<.001			<.001		

Amongst PA hunters, intentions to comply with the carcass import ban increased with respective social norms (b=0.10, p=.016) and decreased with perceived difficulty (b=-0.10, p<.001), and intentions to hunt without using NSLs also increased with perceived social norms (b=0.20, p<.001) and decreased with perceived difficulty (b=-0.12, p=.001). However, neither perceived difficulty (p=.128) nor social norms (p=.217) predicted NY hunters' intentions to hunt without NSLs. I asked NY hunters to what extent they anticipated hunting without NSLs would affect their harvest success, and I found this belief negatively predicted hunters' intentions to hunt without NSLs (b=-0.17, p=.035). Due to space limitations, I could not ask the same question on the PA version of the survey instrument.

To control for the effects of confounding variables, I assessed the relationship between personal norms and intentions while accounting for general hunting characteristics and sociodemographic variables (Table 15, Appendix A) and direct effects from other NAT variables (Table 16, Appendix A). In both cases, I found that personal norms positively impacted intentions to perform the respective behavior. However, perceived efficacy of the risk-minimizing behaviors also positively affected intentions in each model.

Factors Influencing Activation of Personal Norms in Deer Hunters

Having demonstrated the utility of hunters' personal norms in explaining variations in hunters' intentions, I moved on to my second research question asking what influences the activation of hunters' personal norms. Hypothesis 2 predicted that problem awareness and personal responsibility would influence personal norms but

based on my interpretation of NAT as a mediation model, I expected that only personal responsibility would have a direct effect on personal norms. To test my hypothesis, I first identified factors influencing the likelihood of a personal norm activation outcome (whenever a respondent agreed that they felt obligated to perform a risk-minimizing behavior) using binary logistic regression. Second, I used mediation analysis to explore how these variables influence personal norms.

I used measures of problem awareness (CWD problem awareness, likelihood of a CWD introduction, behavior-specific problem awareness), personal responsibility (prevention personal responsibility, behavior-specific efficacy), personality factors (awareness of consequences and responsibility denial), and past years performing the "risky" form of the behavior to predict activation outcomes. My model correctly classified 95% of the 422 cases where personal norms to comply with the carcass import ban were activated and 76% of the 138 non-activation cases (Table 8). In predicting activation of personal norms to hunt without using natural scent lures (NSLs), the model correctly classified 68% of the 125 activation cases and 78% of the 167 non-activation cases in the NY sample and 67% of the 186 activation cases and 92% of the 365 non-activation cases in the PA sample (Table 8).

Behavior-specific efficacy was the only variable to predict personal norm activation in all three models. For every unit increase in perceived efficacy, activation of the personal norm to comply with the import ban became more than twice as likely (OR=2.53, $p<.001$), and activation of the personal norm to hunt without NSLs became more than twice as likely in the NY sample (OR=2.61, $p<.001$) and over three times as likely in the PA sample (OR=3.26, $p<.001$) (Table 9). As the number of past years

performing the "risky" behavior increased, the odds of feeling obligated to avoid NSLs became less likely amongst NY hunters (OR=0.69, $p<.001$) and PA hunters (OR=0.75, $p<.001$), but the odds of feeling obligated to comply with the carcass import ban were unaffected ($p=.108$).

Table 8. Classification table for logistic regression models predicting activation of personal norms to perform risk-minimizing behaviors.

Activation Observed?	Activation Predicted?								
	Personal Norms to Comply with Ban (PA Sample)			Personal Norms to Hunt Without Using Natural Scent Lures (NSLs) (NY Sample)			Personal Norms to Hunt Without Using Natural Scent Lures (NSLs) (PA Sample)		
	No	Yes	% Correct	No	Yes	% Correct	No	Yes	% Correct
No (Not activated)	105	33	76.1	131	36	78.4	334	31	91.5
Yes (Activated)	23	399	94.5	40	85	68.0	62	124	66.7
Overall %			90.0			74.0			83.1

A one-unit increase in prevention personal responsibility (feelings of being responsible for and able to help prevent CWD) increased the likelihood of activation of personal norms to comply with the ban by 2.76 times yet did not affect personal norms to avoid NSLs. Responsibility denial, or the extent to which a participant agreed they would feel less responsible for participating in CWD prevention if others were not helping, was a negative predictor of an activation outcome for personal norms to avoid NSLs but had no association with personal norms to comply with the

Table 9. Variables included in logistic regression models to predict personal norm activation using norm-activation theory (NAT) variables.

Independent Variables	Personal Norms								
	Comply with Import Ban (PA Sample)			Hunt Without Using Natural Scent Lures (NSLs) (NY Sample)			Hunt Without Using Natural Scent Lures (NSLs) (PA Sample)		
	Odds Ratio (OR)	Wald's χ^2	Sig.	Odds Ratio (OR)	Wald's χ^2	Sig.	Odds Ratio (OR)	Wald's χ^2	Sig.
CWD problem awareness	0.68	3.13	.077	0.89	0.24	.627	1.05	0.08	.778
Likelihood of CWD introduction	1.11	0.48	.490	1.01	<0.01	.957	1.06	0.22	.642
Awareness of consequences	0.96	0.05	.816	0.88	0.71	.400	1.15	0.63	.426
Behavior-specific problem awareness	2.30	17.54	<.001	1.20	0.87	.352	1.57	7.36	.007
Prevention personal responsibility	2.76	21.50	<.001	1.09	0.17	.682	1.40	2.63	.105
Responsibility denial	0.89	0.80	.371	0.76	4.72	.030	0.99	0.01	.910
Behavior-specific efficacy	2.53	38.15	<.001	2.61	23.81	<.001	3.26	51.42	<.001
Years performing the "risky" form of behavior	0.75	2.58	.108	0.69	17.72	<.001	0.75	15.18	<.001
Constant	<0.01	28.55	<.001	0.11	3.67	.055	<0.01	37.70	<.001
Nagelkerke R^2	0.660			0.444			0.532		

carcass import ban. Finally, as behavior-specific problem awareness increased, the likelihood that PA hunters' personal norms would be activated increased (for both behaviors), but no effect was identified for NY hunters.

Mediation Analysis

My analyses thus far have allowed me to identify variables influencing the likelihood of hunters' personal norm activation but have not allowed me to explore *how* (i.e., the mechanisms by which) the influence is conveyed. Mediation analysis explores how an independent variable (X) influences a dependent variable (Y) through an indirect effect conveyed by a mediating variable (M). I used mediation analysis to estimate this indirect effect of X on Y as a conjoined effect of X on M and M on Y (Hayes & Rockwood, 2017).

Interpreted as a mediation model, NAT predicts problem awareness will not directly influence personal norms because the relationship is mediated by personal responsibility (Figure 1). Indeed, CWD problem awareness did not generally affect the odds of personal norm activation in my logistic regression models (Table 9). Using mediation analyses, I discovered that CWD problem awareness had an indirect effect on personal norms (via intermediate changes to prevention personal responsibility) in all three cases (Table 10). Furthermore, while controlling for prevention personal responsibility, the relationship disappeared between CWD problem awareness and personal norms to comply with the import ban and NY hunters' personal norms to hunt without using natural scent lures (NSLs).

Table 10. Estimating CWD problem awareness' direct effect on personal norms and indirect effect as mediated by prevention personal responsibility.

	Personal Norms to Comply with Ban (PA Sample)	Personal Norms to Hunt Without Using Natural Scent Lures (NSLs) (NY Sample)	(PA Sample)
	b [95% CI]	*b* [95% CI]	*b* [95% CI]
Indirect Effect	0.44* [0.35, 0.53]	0.22* [0.13, 0.33]	0.24* [0.18, 0.31]
Direct Effect	0.09 [-0.01, 0.18]	<-0.01 [-0.18, 0.17]	0.17* [0.05, 0.29]

*Significant at .05 level.

Nordlund and Garvill (2003) found that general measures of problem awareness positively influenced specific measures of problem awareness, which positively influenced personal norms. I tested the same chain of influence with personal responsibility measures because I expected prevention personal responsibility to increase the odds of personal norm activation, but the effect was inconsistent (Table 9). My mediation analyses confirmed that prevention personal responsibility positively influenced personal norms through increased behavior-specific efficacy in all cases (Table 11). Prevention personal responsibility also had a direct effect on PA hunters' personal norms while controlling for behavior-specific efficacy, which does not negate the indirect effect but suggests the relationship is only partially mediated.

Table 11. Estimating prevention personal responsibility's direct effect on personal norms and indirect effect as mediated by behavior-specific efficacy.

	Personal Norms to Comply with Ban (PA Sample)	Personal Norms to Hunt Without Using Natural Scent Lures (NSLs) (NY Sample)	(PA Sample)
	b [95% CI]	*b* [95% CI]	*b* [95% CI]
Indirect Effect	0.60* [0.48, 0.72]	0.48* [0.35, 0.61]	0.40* [0.33, 0.48]
Direct Effect	0.38* [0.29, 0.47]	0.12 [-0.04, 0.28]	0.20* [0.10, 0.29]

*Significant at .05 level.

Comparing NY and PA Hunters

Hunters traveling out-of-state to hunt in CWD-positive areas (including Pennsylvania) may be at a higher risk of facilitating the movement of CWD and may have different CWD-related beliefs and behaviors based on their experience hunting in an area where CWD has been found. My final research question addressed potential differences between New York residents licensed to hunt in New York (NY hunters) and New York residents licensed to hunt in Pennsylvania (PA hunters). In Hypothesis 3.1, I predicted that PA hunters would be more avid deer hunters who consider deer hunting to have higher personal importance than NY hunters. In Hypothesis 3.2, I predict PA hunters will have lower problem awareness than NY hunters. I used independent samples *t*-tests to explore this research question and test my specific hypotheses.

Hunter Characteristics and Past Hunting Behaviors

PA and NY hunters exhibited differences in some characteristics. PA hunters had hunted deer for more years ($\bar{x}$=38.7 years) than NY hunters ($\bar{x}$=33.9 years) (p<.001), and PA hunters indicated deer hunting was more important to them ($\bar{x}$=3.77) than NY hunters ($\bar{x}$=3.48) (p<.001) (Table 12). PA hunters had typically hunted more days in the New York archery season ($\bar{x}$=2.77) than NY hunters ($\bar{x}$=2.36) (p<.001) but had typically hunted fewer days ($\bar{x}$=3.21) in the New York regular season than NY hunters ($\bar{x}$=3.47) (p<.001).

Table 12. Differences observed between PA and NY hunters.

	PA Hunters	NY Hunters	Independent Samples Test		
	$\bar{x}$ (SD)	$\bar{x}$ (SD)	*t*	*p*	Cohen's *d*
Total years deer hunting	38.7 (16.6)	33.9 (17.5)	4.37	<.001	0.28
Typical days hunting in NY archery season[1]	2.77 (1.28)	2.36 (1.34)	4.86	<.001	0.32
Typical days hunting in NY regular season[1]	3.21 (1.02)	3.47 (0.73)	-4.75	<.001	-0.28
Personal importance of deer hunting[2]	3.77 (0.49)	3.48 (0.75)	6.77	<.001	0.49
CWD problem awareness[3]	3.26 (0.77)	3.43 (0.72)	-3.50	<.001	-0.22
Carcass problem awareness[4]	2.95 (1.05)	3.31 (0.89)	-5.87	<.001	-0.37
Personal norm to hunt without using natural scent lures (NSLs)[5]	3.17 (1.27)	3.40 (1.24)	-2.72	.007	-0.18

[1]Measured on a scale from no days (1), 1-2 days (2), 3-7 days (3), to 8+ days (4).
[2]Measured on a scale from "not at all important" (1) to "very important" (4).
[3]Composite score based on an average of five items measured on a scale from "not at all" (1) to "a great extent" (4).
[4]Measured on a scale from "no risk" (1) to "a great deal of risk" (4).
[5]Measured on a scale from "strongly disagree" (1) to "strongly agree" (5).

PA and NY hunters did not significantly differ in the rate at which they had harvested deer in NY (PA $\bar{x}$=2.94, NY $\bar{x}$=2.76), used natural scent lures (PA $\bar{x}$=1.44, NY $\bar{x}$=1.50), or disposed of carcasses in the trash or at a landfill in the past five years (PA $\bar{x}$=1.20, NY $\bar{x}$=1.14) (Table 17, Appendix A). There was also no significant difference in age between PA and NY hunters (PA $\bar{x}$=57.3 years, NY $\bar{x}$=57.2 years).

Norm-Activation Theory Variables

Differences did exist between PA hunters and NY hunters in measures of norm-activation theory (NAT) variables. Overall, PA hunters scored lower ($\bar{x}$=3.26) on the CWD problem awareness scale than NY hunters ($\bar{x}$=3.43) (p<.001) (Table 12). The CWD problem awareness scale measured the extent to which hunters believed CWD would be a problem for different elements of deer health and hunting. At a behavior-specific level, PA hunters believed bringing a whole carcass back to New York posed less risk of introducing CWD to New York ($\bar{x}$=2.95) than NY hunters ($\bar{x}$=3.31) (p<.001). However, the item on the NY version of the questionnaire broadly referred to out-of-state hunting, while the PA version referred to hunting specifically in PA. PA hunters agreed to a lesser extent that they felt obligated to hunt deer without using natural scent lures ($\bar{x}$=3.17) compared to NY hunters ($\bar{x}$=3.40) (p=.007).

PA and NY hunters reported similar levels of personal responsibility. The prevention personal responsibility scale measured the extent to which hunters ascribed responsibility to themselves to help prevent CWD and believed effective actions are available to help prevent CWD. There was no significant difference in PA and NY hunters' scores on the prevention personal responsibility scale (PA $\bar{x}$=4.17, NY $\bar{x}$=4.11) (Table 17, Appendix A). There was also no significant difference in behavior-specific efficacy or the extent to which PA and NY hunters believed it would help keep CWD out of New York to comply with the carcass import ban (PA $\bar{x}$=3.97, NY $\bar{x}$=4.07) or hunt without using NSLs (PA $\bar{x}$=3.03, NY $\bar{x}$=3.12).

New York residents licensed to hunt in New York (NY hunters) and New York residents licensed to hunt in Pennsylvania (PA hunters) also reported similar activation

of personal norms and intentions to perform risk-minimizing behaviors overall. PA and NY hunters did not differ in their feelings of obligation to help prevent an introduction of CWD to NY (PA $\bar{x}$=4.37, NY $\bar{x}$=4.42) or to ensure they do not personally introduce CWD to New York (PA $\bar{x}$=4.55, NY $\bar{x}$=4.65). NY respondents who were neutral or agreed that they planned to hunt outside of NY in the future (n=191) and PA respondents were not significantly different in their personal norms to comply with the carcass import ban (PA $\bar{x}$=4.11, NY $\bar{x}$=4.28) nor in their intentions to do so (PA $\bar{x}$=4.50, NY $\bar{x}$=4.36). PA and NY hunters also did not differ in their intentions to dispose of their deer carcasses in the trash or by taking them to a landfill (PA $\bar{x}$=3.32, NY $\bar{x}$=3.37).

In sum, PA hunters appeared to be more avid deer hunters with lower problem awareness than NY hunters. However, PA and NY hunters did not demonstrate different levels of personal responsibility or activation of personal norms overall. Ultimately, past hunting behaviors and intentions to perform risk-minimizing behaviors were simiar between PA and NY hunters.

Summary of Results

Using multiple linear regression, I explored Hypothesis 1: Hunters' personal norms to perform risk-minimizing behaviors will positively affect their respective behavioral intentions. My models explained 46% of the variance in PA hunters' intentions to comply with the carcass import ban and 60% and 64% in intentions to avoid using natural scent lures amongst NY and PA hunters, respectively. Personal norms were positive and significant predictors in all models.

Having found personal norms to be significant predictors of hunters' intentions, I used NAT variables to test Hypothesis 2: Problem awareness and personal responsibility will influence personal norms, but under a mediation model interpretation of NAT, only personal responsibility will have a direct effect on personal norms. First, I predicted the odds of personal norm activation using logistic regression. I was able to predict activation of the personal norm to comply with the ban with 90% overall accuracy, the personal norm to avoid natural scent lures in the NY sample with 74% overall accuracy and in the PA sample with 83% overall accuracy. Across all three models, the only variable that was a significant predictor of personal norm activation was behavior-specific efficacy. In each case, increases in perceived efficacy increased the likelihood of norm activation by at least two times.

Interpreted as a mediation model, NAT suggests some variables will exert their influence on subsequent variables indirectly through intermediate changes to mediator variables. To estimate these indirect effects on personal norms, I used mediation analyses. As predicted, CWD problem awareness did not directly influence personal norm activation in the logistic regression models. However, I found that the conjoined effect of CWD problem awareness on prevention personal responsibility and, in turn, prevention personal responsibility's influence on personal norms relayed a significant indirect effect from CWD problem awareness to personal norms. I also found that prevention personal responsibility had an indirect effect on personal norms transmitted by perceived efficacy of the risk-minimizing behaviors.

To address my third research question, I compared New York residents licensed to hunt in New York (NY hunters) and New York residents licensed to hunt

in Pennsylvania (PA hunters). Hypothesis 3.1 was PA hunters will be more avid deer hunters and will consider deer hunting to have higher personal importance than NY hunters. PA hunters responded at a higher rate (35%) than NY hunters (22%) and indicated that deer hunting was more important to them than NY hunters. Hypothesis 3.2 predicted PA hunters would have lower problem awareness than NY hunters. While PA hunters had lower CWD problem awareness and perceived less risk of introducing CWD to NY from bringing whole carcasses back to NY, they did not differ in prevention personal responsibility or perceived efficacy of risk-minimizing behaviors (to help keep CWD out of New York). Overall, PA and NY hunters reported similar past hunting behaviors, personal norms, and intentions to perform risk-minimizing behaviors.

DISCUSSION AND CONCLUSION

Consistent with Hypothesis 1, deer hunters' personal norms positively influenced their intentions to perform CWD risk-minimizing behaviors. I used personal norms, past performance of the "risky" alternate form of a behavior (e.g., bringing a whole cervid carcass back to New York, using natural scent lures), and anticipated costs of performing the risk-minimizing behaviors to predict intentions. With this model, I was able to explain 46% of the variance in PA hunters' intentions to bring only deboned deer meat or cleaned parts back to New York (i.e., comply with the carcass import ban), 60% of the variance in NY hunters' intentions to hunt without using natural scent lures (NSLs) and 64% of the variance in PA hunters' intentions to hunt without NSLs.

Given the strength of the relationship between personal norms and intentions, I explored factors expected to predict activation of personal norms based on norm-activation theory (NAT). My Hypothesis 2 predicted personal norms would be influenced by problem awareness and personal responsibility, but if the mediation model interpretation of NAT is correct, only personal responsibility would directly influence personal norms. The odds of personal norm activation increased for both behaviors with increased behavior-specific efficacy (a measure of personal responsibility), but measures of problem awareness did not predict activation. These results provided some support for Hypothesis 2. Still, I needed to explore further the relationships between variables leading to norm activation to support an interpretation of NAT as a mediation model.

Using mediation analyses, I confirmed that while CWD problem awareness (i.e., CWD risk perceptions) did not have a consistent direct effect on personal norms, it had a significant indirect effect conveyed by prevention personal responsibility. This finding suggests a substantial part of the influence CWD risk perceptions have on personal norms is because CWD risk perceptions influence hunters feeling able and responsible for helping to prevent CWD leading to self-involvement in CWD prevention. Furthermore, I found that a substantial part of prevention personal responsibility's effect on personal norms was because prevention personal responsibility increased behavior-specific efficacy, which in turn increased personal norms. The latter behavior-specific variable had a more proximate influence on increasing personal norms and increased the predictive power of NAT. This finding supports recommendations from scholars to measure NAT concepts at both a general and a behavior-specific level (Nordlund & Garvill, 2003; Steg & de Groot, 2010).

My exploratory factor analysis on measures of problem awareness further supported the case for measuring general and specific beliefs. The analysis suggested one common factor accounted for beliefs that CWD would be a problem for different dimensions of deer health and hunting, but the same factor did not account for beliefs that specific hunting behaviors were problematic (because they pose some risk of introducing CWD to New York). This divergence suggests different underlying constructs influence beliefs at different specificity levels, and measuring beliefs at a general and behavior-specific level is not redundant. While this may not be a shocking finding, it is a reminder of how problematic it is to conflate hunter perceptions that CWD is a problem with perceptions that specific hunting behaviors are a problem.

In comparing New York residents licensed to hunt in New York (NY hunters) and New York residents licensed to hunt in the CWD-positive neighboring state of Pennsylvania (PA hunters), I found support for Hypothesis 3.1, predicting PA hunters would be more avid deer hunters who place more importance on deer hunting than NY hunters. PA hunters had hunted deer for longer, had typically hunted more days in the New York archery season, and said deer hunting was more important to them compared to NY hunters. These comparisons created an image of the average PA hunter being more engaged in deer hunting than the average NY hunter. This conclusion makes sense, given the likelihood of a PA hunter having invested more time and money by nature of hunting in a state where they are not a resident. At minimum, a hunting license is more expensive for a nonresident than a resident. According to the 2022-2023 license fee structure found on the Pennsylvania Game Commission and the New York State Department of Environmental Conservation websites, a Pennsylvania nonresident adult hunting license costs 101.97 USD compared to a New York resident adult hunting license which costs 22 USD. This higher investment in deer hunting would help explain the higher response rate in the PA sample (35%) compared to the NY sample (22%).

While PA hunters appeared to be more avid deer hunters, I also found support for Hypothesis 3.2 predicting that PA hunters would have lower problem awareness (i.e., perceive CWD and specific hunting behaviors as less of a problem) than NY hunters. PA hunters perceived CWD to be less of a problem for different elements of NY deer health and hunting than NY hunters. This result is aligned with other studies suggesting hunters' CWD risk perceptions decrease over time and with experience

with CWD (Needham et al., 2006; Vaske & Miller, 2018). Although CWD was discovered in New York in 2005 (and was quickly contained), New York deer hunters have indicated that CWD is of lower salience because it is not believed to be present in New York (Siemer et al., 2021). Meanwhile, Pennsylvania has been actively managing CWD since it was first discovered in wild deer in 2013. As a result, CWD and associated risks are likely less novel to PA hunters who have been hunting in an area where CWD has been found while NY hunters have not.

In the case of CWD perceptions amongst PA hunters, it is possible that the qualitative characteristics of CWD may be evaluated as less "unknown" and associated with less "dread" as disease management appears to stem catastrophic declines in deer health and deer hunting quality and there continue to be no cases of humans infected with CWD (Cooney & Holsman, 2010). The competency of a natural resource agency in managing CWD may also decrease hunters' risk perceptions because it could foster greater social trust in the responsible agency, which has been linked to lower risk perceptions (Needham & Vaske, 2008). Furthermore, without a rushed management response and media focus on scientific uncertainty, affective or emotional responses to CWD may give way to more analytical reasoning aligned with the low assessed risk of CWD from a technical perspective (Heberlein & Stedman, 2009). More research would need to be done to understand how experience may contribute to lower risk perceptions.

Some scholars have hypothesized that decreasing risk perceptions will lead to reduced hunter engagement with and support for CWD management (Vaske & Miller, 2018). However, PA and NY hunters did not differ in their intentions to perform risk-

minimizing behaviors despite PA hunters believing CWD would be less of a problem compared to NY hunters. The PA/NY similarity in hunter intentions may seem counterintuitive but makes sense in light of my findings that problem awareness' effect on personal norms is indirect and conveyed by personal responsibility (the more proximate variable in the chain of influence on personal norms and intentions). PA and NY hunters did not differ in their sense of responsibility or ability to participate in CWD prevention (i.e., prevention personal responsibility) or, more importantly, in their perceptions that the risk-minimizing behaviors would help keep CWD out of New York (i.e., behavior-specific efficacy).

The proximate influence on hunters' personal norms (and sometimes a direct effect on behavioral intentions) was perceived efficacy, a behavior-specific belief about self-involvement in "the solution" (as opposed to a general belief about "the problem," i.e., CWD risk perceptions). This positive effect of behavior-specific efficacy on hunters' intentions is consistent with other studies finding perceived efficacy to affect hunter engagement in and support for CWD management (Cooney & Holsman, 2010; Holsman et al., 2010; Schroeder et al., 2021; Siemer et al., 2020; Vaske & Miller, 2018).

The importance of efficacy presents a challenge because hunters have demonstrated uncertainty about the effectiveness of CWD management actions, including risk-minimizing behaviors they have been asked to adopt (Holsman et al., 2010; Siemer et al., 2020). Uncertainty among hunters is not too surprising given the documented uncertainty within the scientific community on issues ranging from the efficacy of hunting pressure in suppressing CWD prevalence levels, relative risks of

different transmission routes, and the transmission potential of CWD to infect humans (Adamowicz et al., 2021; Conner et al., 2021; Heberlein & Stedman, 2009; Mysterud et al., 2019; Schuler et al., 2016).

If wildlife managers and disease experts are uncertain about these actions' efficacy, they cannot convince hunters based on the current best available knowledge. New York deer hunters participating in a focus group appeared to be open to being convinced that risk-minimizing behaviors were the "right thing" to do, but the feeling was that the ball was in the court of wildlife managers and disease experts to make the next move (Siemer et al., 2021). I suggest there is an inherent need to 1) reduce underlying scientific uncertainty around risk-minimizing behaviors and 2) inform CWD risk communication with these findings.

In situations where reducing scientific uncertainty is not possible, I suggest there are other ways to help hunters assess the efficacy of recommended risk-minimizing behaviors. For example, the efficacy of hunting without using natural (deer urine-based) scent lures (NSLs) may be difficult to quantify because it is unclear if a bottle contains CWD prions and if spreading lures in the environment will transmit CWD. However, a comparison can be drawn between the efficacy of avoiding NSLs and other options based on scientific evidence. This approach was exemplified in a bulletin on CWD management on private lands, which identified not dispersing deer urine on the land as a "Best Practice," followed by a ranking of behaviors from "Low Risk" (only apply deer urine to materials that can be removed from the land to avoid further transmission) to "High Risk" (apply deer urine of unknown origin directly on the land) (Hewitt et al., 2021; Wisconsin Department of Natural Resources, 2019).

Limitations and Future Studies

NAT suggests that the relationship between personal norms and intentions is predicated on the identified problem having consequences that involve something of value to the individual, i.e., some degree of value relevance. In the current study, value relevance was operationalized as the extent to which hunters perceived a CWD introduction and lack of participation in CWD prevention to have negative consequences for things of value to them. While value relevance was high amongst survey respondents (which provided a data point in itself), the lack of variation limited my ability to explore the relationship between personal norms and intentions across different levels of value relevance. Therefore, I am uncertain about the generalizability of my findings to cases where value relevance is not high. Future research could determine the appropriateness of studying personal normative influences when hunters demonstrate low or no value relevance.

Another limitation of my study was that survey respondents appeared to differ from nonrespondents on some key measures. From nonresponse interviews, I gleaned that nonrespondents may be less invested or engaged deer hunters and less worried about their behaviors introducing CWD to New York compared to respondents. If genuine, these differences suggest survey response could have been biased by the content of the survey, which causes some concern about the representativeness of my data (Stedman et al., 2019). As a novel application of NAT, I am unsure how the observed differences may be expected to relate to the larger, more complex NAT concepts and the relationships between variables amongst nonrespondents (hence my decision not to weight the data).

As I note in my findings from the problem awareness exploratory factor analysis, I believe a different underlying construct influences perceptions that CWD is a problem and that specific hunting behaviors are a problem. In the case of nonrespondents, it is unclear whether CWD problem awareness is lower, if behavior-specific problem awareness is lower, or neither, or both. A future study could further assess the problem awareness construct in a survey without a CWD focus to measure characteristics of hunters less prone to have a response bias to a CWD-specific survey. It would also be interesting to assess whether perceived efficacy is as impactful across low levels of problem awareness or if there is a threshold below which wildlife managers and disease experts should focus on deer hunter problem awareness.

An assumption of this study (and all studies that measure personal norms using a questionnaire) was that personal norms could be activated simply by asking participants questions about their personal norms on the survey instrument. Personal norms are predicted to be situationally constructed, so any measure outside of the intended situation is limited by an individual's ability to anticipate how they would feel in that situation (Schwartz, 1977). While we believe we were able to activate personal norms using the survey instrument (and activated personal norms increased behavioral intentions), it was outside of the scope of this study to test whether personal norms could be activated (and therefore increase behavior intentions) through other forms of communication (e.g., social media posts, magazine articles).

Finally, in a real-world setting, it is conceivable that activation of personal norms is dynamic and subject to change after initial activation. NAT suggests a "reassessment" process follows activation if substantial costs of acting in accordance

with personal norms are anticipated (Schwartz, 1977). For example, believing others will not join in a "collective action" solution could lead to reassessment and subsequent changes in personal norm activation based on responsibility denial. This process may be a vital consideration for CWD risk-minimizing behaviors. I discovered that anticipated difficulty of the behavior (a dimension of anticipated cost) negatively influenced intentions, and my measure of responsibility denial predicted lower odds of activating NY hunters' personal norms to hunt without using natural scent lures.

Conclusions

When human dimensions are not considered in CWD management, the resulting discord can give the appearance that deer hunters and wildlife managers are not on the same side against CWD. In reality, both parties have some sense of obligation to protect deer health and hunting from the adverse effects of CWD. For wildlife managers, there is a formal obligation under public trust responsibilities. In this study, I have demonstrated the influence deer hunters' feelings of personal obligation (i.e., personal norms) have on their intentions to perform CWD risk-minimizing behaviors. Even when intentions are rooted in internal values and normative structures, my findings suggest perceived efficacy positively affects activation of these internalized standards in hunters. As a result, I suggest focusing on 1) reducing the underlying scientific uncertainty about CWD management actions and 2) informing CWD risk communication with these findings will help achieve wildlife and disease management goals.

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APPENDIX A: SUPPLEMENTARY ANALYSES

Table 13. Results of tests to determine appropriateness of exploratory factor analyses.

		Value Relevance		Problem Awareness		Personal Responsibility	
		NY Sample	PA Sample	NY Sample	PA Sample	NY Sample	PA Sample
KMO		0.71	0.68	0.87	0.84	0.74	0.87
Bartlett's Test	χ^2	478.0	595.2	1660.6	2952.7	187.3	2156.7
	Sig.	<.001	<.001	<.001	<.001	<.001	<.001

Table 14. Comparing eigenvalues calculated from raw data and random data sets using parallel analysis to determine the number of factors to retain[1].

		Eigenvalues			
		NY Sample		PA Sample	
EFA	Root	Raw data[2]	Random data[3]	Raw data[2]	Random data[3]
Value Relevance	1	1.83	0.21	1.51	0.16
	2	0.06	0.08	0.07	0.06
	3	-0.12	0.00	-0.13	0.01
	4	-0.18	-0.06	-0.21	-0.04
Problem Awareness	1	4.28	0.43	3.97	0.30
	2	1.08	0.31	0.92	0.22
	3	0.15	0.23	0.35	0.16
	4	0.12	0.17	0.14	0.12
	5	0.03	0.11	0.07	0.07
	6	0.01	0.06	-0.03	0.04
	7	-0.02	0.00	-0.06	0.00
	8	-0.11	-0.04	-0.10	-0.04
	9	-0.13	-0.09	-0.14	-0.07
	10	-0.17	-0.14	-0.17	-0.10
	11	-0.21	-0.19	-0.24	-0.15

Table 14. *continued…*					
Personal Responsibility	1	3.53	1.21	3.77	0.27
	2	0.68	0.84	0.47	0.19
	3	0.51	0.59	0.24	0.13
	4	0.18	0.38	0.05	0.08
	5	0.13	0.20	-0.03	0.04
	6	-0.04	0.06	-0.07	-0.01
	7	-0.14	-0.08	-0.08	-0.04
	8	-0.18	-0.20	-0.14	-0.08
	9	-0.23	-0.31	-0.27	-0.13

[1]Parallel analysis suggests a factor should be retained if the raw data eigenvalue is larger than the random data eigenvalue (larger of two values indicated in bold font).
[2]Reports eigenvalue computed from the reduced correlation matrix using the raw data.
[3]Reports 95th percentile value based on parallel analysis with 1000 random data sets.

Table 15. Predicting hunters' behavioral intentions while accounting for the effect of general hunting characteristics and sociodemographic variables.

	Intentions		
	Comply with Import Ban	Hunt Without Using Natural Scent Lures (NSLs)	
Independent Variables	(PA Sample)	(NY Sample)	(PA Sample)
	b (SE)	*b* (SE)	*b* (SE)
(Constant)	2.57 (0.17)***	1.94 (0.29)***	0.84 (0.19)***
Personal norms to perform risk-minimizing behavior	0.48 (0.03)***	0.61 (0.05)***	0.70 (0.03)***
Years performing the "risky" form of the behavior	-0.18 (0.05)***	-0.24 (0.03)***	-0.16 (0.02)***
Total years deer hunting	<-0.01 (<0.01)	<-0.01 (<0.01)	0.01 (<0.01)**
Education	0.01 (0.02)	-0.03 (0.04)	0.05 (0.03)
Political views	<-0.01 (0.03)	0.01 (0.05)	0.02 (0.04)
R^2	0.390	0.557	0.600
Adj. R^2	0.384	0.550	0.596
df (Residual)	498	278	540
F	63.70	70.04	161.67
Sig.	<.001	<.001	<.001

***p<.001; **p<.01; *p<.05

Table 16. Predicting hunters' behavioral intentions while accounting for direct effects from other norm-activation theory (NAT) variables.

	Intentions		
	Comply with Import Ban	Hunt Without Using Natural Scent Lures (NSLs)	
Independent Variables	(PA Sample)	(NY Sample)	(PA Sample)
	b (SE)	*b* (SE)	*b* (SE)
(Constant)	2.69 (0.18)***	-0.17 (0.34)	0.03 (0.20)
Personal norms to perform risk-minimizing behavior	0.44 (0.04)***	0.63 (0.06)***	0.59 (0.04)***
CWD problem awareness	-0.15 (0.05)**	0.05 (0.09)	<0.01 (0.05)
Likelihood of CWD introduction	0.02 (0.03)	0.07 (0.06)	0.06 (0.04)
Behavior-specific problem awareness	-0.02 (0.05)	0.11 (0.08)	0.10 (0.05)
Prevention personal responsibility	<0.01 (0.05)	0.09 (0.08)	0.08 (0.05)
Behavior-specific efficacy	0.11 (0.04)**	0.16 (0.07)*	0.22 (0.05)***
R^2	0.402	0.551	0.599
Adj. R^2	0.396	0.542	0.595
df (residual)	590	306	580
F	66.220	62.630	144.609
Sig.	<.001	<.001	<.001

***p<.001; **p<.01; *p<.05

Table 17. Similarities between PA and NY hunters.

	PA Hunters	NY Hunters	Independent Samples Test	
	M (SD)	M (SD)	*t*	*p*
Years harvesting deer in NY	2.94 (1.97)	2.76 (1.83)	1.49	.136
Years using natural scent lures	1.44 (1.98)	1.50 (1.94)	-0.48	.634
Years disposing of carcass in trash/landfill	1.20 (1.88)	1.14 (1.77)	0.50	.620
Age	57.32 (15.04)	57.2 (15.66)	0.13	.900
Prevention personal responsibility[1]	4.17 (0.93)	4.11 (0.81)	1.01	.313
Efficacy of complying with ban[2]	3.97 (1.29)	4.07 (1.12)	-1.34	.182
Efficacy of avoiding NSLs[2]	3.03 (1.23)	3.12 (1.22)	-1.06	.290
Personal norm to help prevent CWD introduction[2]	4.37 (0.91)	4.42 (0.89)	-0.89	.375
Personal norm to <u>not</u> personally introduce CWD[2]	4.55 (0.86)	4.65 (0.77)	-1.78	.075
Personal norm to comply with carcass import ban[2,3]	4.11 (1.24)	4.28 (1.04)	-1.91	.056
Intention to comply with carcass import ban[2,3]	4.50 (0.99)	4.36 (1.00)	1.64	.102
Intention to dispose of carcass in the trash/landfill[2]	3.32 (1.56)	3.37 (1.59)	-0.49	.624

[1]Composite score based on an average of four items measured on a scale from "strongly disagree" (1) to "strongly agree" (5).
[2]Measured on a scale from "strongly disagree" (1) to "strongly agree" (5).
[3]Includes hunters from NY sample who were neutral or agreed that they planned to hunt outside of New York in the future (n=191).

APPENDIX B: SURVEY INSTRUMENTS

NY Sample Survey Instrument

Deer Hunters and
Chronic Wasting Disease (CWD) Prevention

Research conducted for the
NYS Department of Environmental Conservation (DEC)
Division of Fish and Wildlife
by the
Center for Conservation Social Sciences
Department of Natural Resources and the Environment
Cornell University

Chronic wasting disease (CWD) is a fatal disease of the cervid (deer, elk, moose, caribou) family. It is caused by an abnormal protein called a prion. In 2005, CWD was discovered in captive deer facilities in New York (NY) and then in two wild white-tailed deer nearby. However, over the last 15 years, it has not been found again in the state. As such, NY is considered free of CWD.

Keeping CWD out of NY is a priority for DEC. DEC has asked hunters to help prevent the introduction and spread of CWD by adopting risk-minimizing behaviors.

The goal of this survey is to understand hunters' views and behaviors related to CWD in NY to improve DEC communication with hunters. Input from **everyone** who receives this questionnaire is valuable, not just those who have strong opinions about deer hunting or CWD. We want the results of the survey to reflect the perspectives of all deer hunters in NY.

Your identity will be kept confidential and the information you give us will never be associated with your name.

Please complete this questionnaire as soon as you can, seal it with the white re-sealable label provided, and drop it in any mailbox; ***return postage has been pre-paid***.

Part I: General Deer Hunting Questions

1) **About how many total years have you hunted deer?** *(Fill in the number.)*

_____

2) **How important is deer hunting to you personally?** (*Circle one number*.)

Not at all important	Slightly important	Moderately important	Very important
1	2	3	4

3) **Over the last 5 years, about how many <u>days per year</u> did you typically hunt during the following seasons in NY?** (*Check one box per line*.)

Number of days hunted:	None	1-2	3-7	8+
Archery seasons	□	□	□	□
Regular firearms seasons	□	□	□	□
Muzzleloader seasons	□	□	□	□

4) **Hunters have different opinions about how they should act as deer hunters. Please indicate your level of agreement with the following statements.** (*Circle one number per line*.)

	Strongly disagree	Slightly disagree	Neutral	Slightly agree	Strongly agree
It is important to me to be an ethical deer hunter.	1	2	3	4	5
The health of the NY deer herd is an important issue to me.	1	2	3	4	5
I think my current deer hunting behaviors impact future deer hunters.	1	2	3	4	5
I think putting effort into keeping CWD out of NY is part of being an ethical hunter.	1	2	3	4	5

Part 2: Specific Deer Hunting Behaviors

5) Over the past 5 years, how many different years have you done the following <u>in NY</u>? (*Circle one number per line.*)

	Number of years:					
Used a natural (deer urine-based) scent lure	0	1	2	3	4	5
Harvested a deer	0	1	2	3	4	5
Processed (butchered) the deer myself	0	1	2	3	4	5
Disposed of my deer carcass by leaving it on the land	0	1	2	3	4	5
Disposed of my deer carcass by putting it in the trash or taking it to a landfill	0	1	2	3	4	5
Taken the deer to a processor	0	1	2	3	4	5

6) How difficult would it be for you to hunt deer <u>without</u> using natural scent lures? (*Circle one number.*)

Very easy	**Somewhat easy**	**Neither easy nor difficult**	**Somewhat difficult**	**Very difficult**
1	2	3	4	5

7) How much do you think hunting deer <u>without</u> using natural scent lures would affect your deer harvest success? (*Circle one number.*)

Not at all	**Slightly**	**Moderately**	**A great deal**
1	2	3	4

8) Over the past 5 years, how often did you hunt deer, elk, moose, or caribou <u>outside of NY</u>? *(Circle one number.)*

1 Never >>>>>> **Skip to Question # 11**
2 At least once
3 Multiple times

9) **Over the past 5 years, how many different years have you done the following outside of NY?** (*Circle one number per line*.)

	Number of years:					
Harvested a deer, elk, moose, or caribou outside of NY	0	1	2	3	4	5
Taken the harvested animal to a processor or taxidermist before returning to NY	0	1	2	3	4	5
Processed (butchered) the harvested animal myself before returning to NY	0	1	2	3	4	5
Brought the harvested animal back to NY to process	0	1	2	3	4	5

10) **How difficult would it be for you to bring only deboned meat or cleaned parts back to NY after hunting outside of NY?** Note: "Cleaned parts" includes skull caps, antlers with no flesh, raw or processed capes/hides, teeth/lower jaws, and finished taxidermy products. (*Circle one number*.)

Very easy	Somewhat easy	Neither easy nor difficult	Somewhat difficult	Very difficult
1	2	3	4	5

11) **To what degree does your concern about CWD influence the following?** (*Circle one number per line*.)

	Not at all	Slightly	Moderately	A great deal
Your carcass processing and disposal methods	1	2	3	4
Your decision about whether to use natural (deer urine-based) scent lures	1	2	3	4
Your decision about whether to hunt outside of NY	1	2	3	4
If you hunt outside of NY, your handling of deer, elk, moose, or caribou harvested outside of NY	1	2	3	4

Part 3: Your Beliefs About CWD

These questions will help DEC understand your beliefs about CWD and factors that influence the risk of a CWD introduction.

12) Please indicate to what extent you think that CWD would be a problem <u>if it were to be introduced to NY</u>. (*Circle one number per line.*)

To what extent would CWD be a problem for…	**Not at all**	**Slight**	**Moderate**	**A great extent**
The health of deer in areas where I hunt in NY	1	2	3	4
The health of deer throughout NY	1	2	3	4
NY deer population levels	1	2	3	4
My deer hunting satisfaction in NY	1	2	3	4
My willingness to consume venison	1	2	3	4

13) How unlikely or likely do you think it is that CWD will spread <u>to NY</u> in the next 5 years? (*Circle one number.*)

Very unlikely	**Slightly unlikely**	**Neither likely nor unlikely**	**Slightly likely**	**Very likely**
1	2	3	4	5

14) To what degree do you believe the following people are responsible for helping to prevent a CWD introduction to NY? *(Circle one number per line.)*

	Not at all responsible	**Slightly responsible**	**Somewhat responsible**	**Very responsible**
Hunters	1	2	3	4
Captive deer owners	1	2	3	4
DEC wildlife managers	1	2	3	4

15) To what degree do you believe the following actions pose a risk of introducing CWD to NY? *(Circle one number per line.)*

	No risk	**Slight risk**	**Moderate risk**	**A great deal of risk**
Using natural scent lures	1	2	3	4
Hunting outside of NY	1	2	3	4
Hunting in an area where CWD has been found	1	2	3	4
Bringing whole carcasses back to NY after hunting outside of NY	1	2	3	4
Importing finished taxidermy mounts	1	2	3	4

16) DEC believes hunters can help reduce the risk of introducing CWD to NY. Please indicate your level of agreement with these statements about hunter actions.

(Circle one number per line.)	**Strongly disagree**	**Slightly disagree**	**Neutral**	**Slightly agree**	**Strongly agree**
There are actions hunters can take to help control the spread of CWD.	1	2	3	4	5
Hunting deer without using natural scent lures helps to keep CWD out of NY.	1	2	3	4	5
Bringing only deboned meat or cleaned parts back to NY after hunting outside of NY helps to keep CWD out of NY.	1	2	3	4	5
Hunters I know have changed their behavior to help keep CWD out of NY.	1	2	3	4	5
I have changed my behavior to help keep CWD out of NY.	1	2	3	4	5

Part 4: Your Role in CWD Prevention

These questions will help DEC understand how you view your personal role in helping to keep CWD out of NY.

17) Consider the people whose opinions matter the most to you. To what extent do you agree that they think you should do the following? (*Circle one number per line.*)

The people who matter most to me think I should…	**Strongly disagree**	**Slightly disagree**	**Neutral**	**Slightly agree**	**Strongly agree**
Hunt deer without using natural scent lures	1	2	3	4	5
Not hunt in an area where CWD has been found	1	2	3	4	5
Bring only deboned meat or cleaned parts back to NY after hunting outside of NY	1	2	3	4	5

18) Hunters perceive their role in helping to prevent a CWD introduction differently. Please indicate your level of agreement with the following statements.

(*Circle one number per line.*)	**Strongly disagree**	**Slightly disagree**	**Neutral**	**Slightly agree**	**Strongly agree**
I am partially responsible for preventing a CWD introduction to NY.	1	2	3	4	5
My participation in CWD prevention helps keep CWD out of NY.	1	2	3	4	5
If I did not put effort into keeping CWD out of NY, I would feel like I was endangering the NY deer hunting experience.	1	2	3	4	5
If other hunters do not participate in CWD prevention, I will feel less responsible to do so.	1	2	3	4	5

19) Hunters have different opinions about their personal duty to perform certain behaviors. Please indicate your level of agreement with the following statements.

(*Circle one number per line.*)	**Strongly disagree**	**Slightly disagree**	**Neutral**	**Slightly agree**	**Strongly agree**
I feel a strong moral obligation to help prevent an introduction of CWD to NY.	1	2	3	4	5
I feel a strong moral obligation to hunt deer without using natural scent lures.	1	2	3	4	5
If I hunt outside NY, I feel a strong moral obligation to bring only deboned meat or cleaned parts back to NY.	1	2	3	4	5
I feel a strong moral obligation to ensure that I do not personally introduce CWD to NY.	1	2	3	4	5

20) Hunters differ in their behaviors. To what extent do you agree that you plan to take the following actions within the next 3 years? (*Circle one number per line.*)

Within the next 3 years, I plan to…	**Strongly disagree**	**Slightly disagree**	**Neutral**	**Slightly agree**	**Strongly agree**
Never use natural scent lures to hunt deer	1	2	3	4	5
Take deer I harvest to a processor	1	2	3	4	5
Dispose of my deer carcasses by putting them in the trash or taking them to a landfill	1	2	3	4	5
Hunt deer, elk, moose, or caribou outside of NY	1	2	3	4	5
If I hunt outside NY, bring only deboned meat or cleaned parts back to NY	1	2	3	4	5

Part 5: Your Background Information

By providing a little more information about yourself, you will help DEC to understand the concerns of all types of hunters.

21) What is the highest degree or level of school you have completed? (*Circle one number*.)

1 Less than high school diploma or equivalent
2 High school diploma or equivalent
3 Some college, no degree
4 Associate degree
5 Bachelor's degree
6 Masters, professional, or PhD degree

22) In what year were you born? (*Fill in the year*.) _____

23) What is your gender? (*Circle one number*.)

1 Female
2 Male
3 Prefer not to say
4 Prefer to self-describe: _____

24) How would you describe your political views? (*Circle one number*.)

Very conservative	Slightly conservative	Moderate	Slightly liberal	Very liberal
1	2	3	4	5

PA Sample Survey Instrument

Deer Hunters and
Chronic Wasting Disease (CWD) Prevention

Research conducted for the
NYS Department of Environmental Conservation (DEC)
Division of Fish and Wildlife
by the
Center for Conservation Social Sciences
Department of Natural Resources and the Environment
Cornell University

Chronic wasting disease (CWD) is a fatal disease of the cervid (deer, elk, moose, caribou) family. It is caused by an abnormal protein called a prion. In 2005, CWD was discovered in captive deer facilities in New York (NY) and then in two wild white-tailed deer nearby. However, over the last 15 years, it has not been found again in the state. As such, NY is considered free of CWD.

Keeping CWD out of NY is a priority for DEC. DEC has asked hunters to help prevent the introduction and spread of CWD by adopting risk-minimizing behaviors when they hunt in states, such as Pennsylvania, where CWD has been found.

You have been selected to participate in this survey because you are a NY resident who has hunted in Pennsylvania. **We will ask you about both your hunting in NY and your hunting in PA.**

The goal of this survey is to understand hunters' views and behaviors related to CWD to improve DEC communication with hunters. Input from **everyone** who receives this questionnaire is valuable, not just those who have strong opinions about deer hunting or CWD.

Your identity will be kept confidential and the information you give us will never be associated with your name.

Please complete this questionnaire as soon as you can, seal it with the white re-sealable label provided, and drop it in any mailbox; ***return postage has been pre-paid***.

Part I: General Deer Hunting Questions

1) About how many total years have you hunted deer? *(Fill in the number.)*

_____

2) How important is deer hunting to you personally? (*Circle one number*.)

Not at all important	Slightly important	Moderately important	Very important
1	2	3	4

3) Hunters have different opinions about how they should act as deer hunters. Please indicate your level of agreement with the following statements. (*Circle one number per line*.)

	Strongly disagree	Slightly disagree	Neutral	Slightly agree	Strongly agree
It is important to me to be an ethical deer hunter.	1	2	3	4	5
The health of the NY deer herd is an important issue to me.	1	2	3	4	5
I think my current deer hunting behaviors impact future deer hunters.	1	2	3	4	5
I think putting effort into keeping CWD out of NY is part of being an ethical hunter.	1	2	3	4	5

4) Over the last 5 years, about how many <u>days per year</u> did you typically hunt during the following seasons <u>in NY</u>? (*Check one box per line*.)

Number of days hunted <u>in NY</u>:	None	1-2	3-7	8+
Archery seasons	□	□	□	□
Regular firearms seasons	□	□	□	□
Muzzleloader seasons	□	□	□	□

5) Over the last 5 years, about how many <u>days per year</u> did you typically hunt during the following seasons <u>in PA</u>? (*Check one box per line.*)

Number of days hunted <u>in PA</u>:	**None**	**1-2**	**3-7**	**8+**
Archery deer seasons	☐	☐	☐	☐
Regular and special firearms deer seasons	☐	☐	☐	☐
Muzzleloader (including flintlock) deer seasons	☐	☐	☐	☐
Elk seasons	☐	☐	☐	☐

Part 2: Specific Deer Hunting Behaviors

6) Over the past 5 years, how many different years have you done the following <u>in NY</u>? (*Circle one number per line.*)

	Number of years:					
Used a natural (deer urine-based) scent lure	0	1	2	3	4	5
Harvested a deer	0	1	2	3	4	5
Processed (butchered) the deer myself	0	1	2	3	4	5
Disposed of my deer carcass by leaving it on the land	0	1	2	3	4	5
Disposed of my deer carcass by putting it in the trash or taking it to a landfill	0	1	2	3	4	5
Taken the deer to a processor	0	1	2	3	4	5

7) How difficult would it be for you to hunt deer <u>without</u> using natural scent lures? (*Circle one number.*)

Very easy	**Somewhat easy**	**Neither easy nor difficult**	**Somewhat difficult**	**Very difficult**
1	2	3	4	5

8) Over the past 5 years, how many different years have you done the following <u>in PA</u>? (*Circle one number per line.*)

	Number of years:					
Harvested a deer or elk <u>in PA</u>	0	1	2	3	4	5
Taken the deer or elk to a processor or taxidermist before returning to NY	0	1	2	3	4	5
Processed (butchered) the deer or elk myself before returning to NY	0	1	2	3	4	5
Brought the deer or elk back to NY to process	0	1	2	3	4	5

9) How difficult would it be for you to bring only deboned meat or cleaned parts back to NY after hunting <u>in PA</u>? Note: "Cleaned parts" includes skull caps, antlers with no flesh, raw or processed capes/hides, teeth/lower jaws, and finished taxidermy products. (*Circle one number.*)

Very easy	**Somewhat easy**	**Neither easy nor difficult**	**Somewhat difficult**	**Very difficult**
1	2	3	4	5

10) To what degree does your concern about CWD influence the following? (*Circle one number per line.*)

	Not at all	**Slightly**	**Moderately**	**A great deal**
Your carcass processing and disposal methods	1	2	3	4
Your decision about whether to use natural (deer urine-based) scent lures	1	2	3	4
Your decision about whether to hunt <u>in PA</u>	1	2	3	4
Your handling of deer or elk harvested <u>in PA</u>	1	2	3	4

Part 3: Your Beliefs About CWD

These questions will help DEC understand your beliefs about CWD and factors that influence the risk of a CWD introduction.

11) Please indicate to what extent you think that CWD would be a problem <u>if it were to be introduced to NY</u>. (*Circle one number per line.*)

To what extent would CWD be a problem for…	**Not at all**	**Slight**	**Moderate**	**A great extent**
The health of deer in areas where I hunt in NY	1	2	3	4
The health of deer throughout NY	1	2	3	4
NY deer population levels	1	2	3	4
My deer hunting satisfaction in NY	1	2	3	4
My willingness to consume venison	1	2	3	4

12) How unlikely or likely do you think it is that CWD will spread <u>to NY</u> in the next 5 years? (*Circle one number.*)

Very unlikely	**Slightly unlikely**	**Neither likely nor unlikely**	**Slightly likely**	**Very likely**
1	2	3	4	5

13) To what degree do you believe the following people are responsible for helping to prevent a CWD introduction to NY? *(Circle one number per line.)*

	Not at all responsible	**Slightly responsible**	**Somewhat responsible**	**Very responsible**
Hunters	1	2	3	4
Captive deer owners	1	2	3	4
DEC wildlife managers	1	2	3	4

14) To what degree do you believe the following actions pose a risk of introducing CWD to NY? *(Circle one number per line.)*

	No risk	**Slight risk**	**Moderate risk**	**A great deal of risk**
Using natural scent lures	1	2	3	4
Hunting outside of NY	1	2	3	4
Hunting in an area where CWD has been found	1	2	3	4
Bringing whole carcasses back to NY after hunting in PA	1	2	3	4
Importing finished taxidermy mounts	1	2	3	4

15) DEC believes hunters can help reduce the risk of introducing CWD to NY. Please indicate your level of agreement with these statements about hunter actions.

(Circle one number per line.)	**Strongly disagree**	**Slightly disagree**	**Neutral**	**Slightly agree**	**Strongly agree**
There are actions hunters can take to help control the spread of CWD.	1	2	3	4	5
Hunting deer without using natural scent lures helps to keep CWD out of NY.	1	2	3	4	5
Bringing only deboned meat or cleaned parts back to NY after hunting in PA helps to keep CWD out of NY.	1	2	3	4	5
Hunters I know have changed their behavior to help keep CWD out of NY.	1	2	3	4	5
I have changed my behavior to help keep CWD out of NY.	1	2	3	4	5

Part 4: Your Role in CWD Prevention

These questions will help DEC understand how you view your personal role in helping to keep CWD out of NY.

16) Consider the people whose opinions matter the most to you. To what extent do you agree that they think you should do the following? (*Circle one number per line.*)

The people who matter most to me think I should…	**Strongly disagree**	**Slightly disagree**	**Neutral**	**Slightly agree**	**Strongly agree**
Hunt deer without using natural scent lures	1	2	3	4	5
Not hunt in an area where CWD has been found	1	2	3	4	5
Bring only deboned meat or cleaned parts back to NY after hunting in PA	1	2	3	4	5

17) Hunters perceive their role in helping to prevent a CWD introduction differently. Please indicate your level of agreement with the following statements.

(*Circle one number per line.*)	**Strongly disagree**	**Slightly disagree**	**Neutral**	**Slightly agree**	**Strongly agree**
I am partially responsible for preventing a CWD introduction to NY.	1	2	3	4	5
My participation in CWD prevention helps keep CWD out of NY.	1	2	3	4	5
If I did not put effort into keeping CWD out of NY, I would feel like I was endangering the NY deer hunting experience.	1	2	3	4	5
If other hunters do not participate in CWD prevention, I will feel less responsible to do so.	1	2	3	4	5

18) Hunters have different opinions about their personal duty to perform certain behaviors. Please indicate your level of agreement with the following statements.

(*Circle one number per line.*)	**Strongly disagree**	**Slightly disagree**	**Neutral**	**Slightly agree**	**Strongly agree**
I feel a strong moral obligation to help prevent an introduction of CWD to NY.	1	2	3	4	5
I feel a strong moral obligation to hunt deer without using natural scent lures.	1	2	3	4	5
I feel a strong moral obligation to bring only deboned meat or cleaned parts back to NY after hunting in PA.	1	2	3	4	5
I feel a strong moral obligation to ensure that I do not personally introduce CWD to NY.	1	2	3	4	5

19) Hunters differ in their behaviors. To what extent do you agree that you plan to take the following actions within the next 3 years? (*Circle one number per line.*)

Within the next 3 years, I plan to…	**Strongly disagree**	**Slightly disagree**	**Neutral**	**Slightly agree**	**Strongly agree**
Never use natural scent lures to hunt deer	1	2	3	4	5
Take deer I harvest to a processor	1	2	3	4	5
Dispose of my deer carcasses by putting them in the trash or taking them to a landfill	1	2	3	4	5
Hunt deer or elk in PA	1	2	3	4	5
Bring only deboned meat or cleaned parts back to NY after hunting in PA	1	2	3	4	5

Part 5: Your Background Information

By providing a little more information about yourself, you will help DEC to understand the concerns of all types of hunters.

20) What is the highest degree or level of school you have completed? (*Circle one number*.)

1 Less than high school diploma or equivalent
2 High school diploma or equivalent
3 Some college, no degree
4 Associate degree
5 Bachelor's degree
6 Masters, professional, or PhD degree

21) In what year were you born? (*Fill in the year*.) _____

22) What is your gender? (*Circle one number*.)

1 Female
2 Male
3 Prefer not to say
4 Prefer to self-describe: _____

23) How would you describe your political views? (*Circle one number*.)

Very conservative	Slightly conservative	Moderate	Slightly liberal	Very liberal
1	2	3	4	5