ABSTRACT

LEROSE, CATHERINE S. Hunter Perspectives on Chronic Wasting Disease Management in North Carolina and South Carolina. (Under the direction of Dr. Nils Peterson and Dr. Lincoln Larson).

Chronic wasting disease (CWD) in white-tailed deer populations is a growing challenge for wildlife managers. A critical aspect of CWD management has centered on understanding and influencing hunter behaviors. The historical drivers of hunter perceptions and behaviors, however, may have shifted in response to recent waves of political populism and the COVID-19 pandemic. In this study, we investigated how political identity predicted hunters' risk perception about CWD and CWD management strategies in North Carolina and South Carolina. We found that a hunter's political identity predicted their risk perception and management preferences for CWD. Moderate and liberal hunters perceive a higher risk for items relating to CWD, a higher level of concern for CWD, are less likely to maintain their hunting behavior in an area impacted with CWD, and are more likely to accept agency intervention to manage CWD compared to conservative hunters. Our findings build on previous research that evaluated the role that political identification may have as a driver for wildlife disease management. We also wanted to develop our understanding on one specific component of CWD management in particular: how to pay for it. We compared hunters' willingness to pay (WTP) estimates for CWD testing and disposal reported from different survey modes and contingent valuation (CV) methods. We found that the predicted mean WTP estimates were lower on our online survey than our phone survey, possibly due to social desirability bias. We also found that predicted mean WTP estimates from the open-ended questions were similar to those from the dichotomous choice questions. These findings can assist researchers hoping to identify and administer easy, efficient methods to determine hunters' WTP for management practices for disease control. We hope that this study provides a baseline for wildlife managers to apply management techniques for CWD and other wildlife diseases that are supported by the hunting community at large.

Hunter Perspectives on Chronic Wasting Disease Management in North Carolina and South Carolina

by

Catherine Sam Lerose

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BIOGRAPHY

Catherine Sam Lerose was born in Long Island, New York to parents Cynthia and Douglas Lerose. She attended the University of Massachusetts Amherst in 2017 and completed her Bachelor of Science degree in biology with a minor in chemistry in 2021. During her undergraduate studies, she was a research assistant in an evolution and development ichthyology lab. In between her undergraduate and graduate education, she worked as a wildlife rehabilitation intern for Sweetbriar Nature Center in Smithtown, New York during the summer of 2021. She moved to Raleigh, North Carolina in August of 2021 to earn her Master of Science degree in the Fisheries, Wildlife, and Conservation Biology program within the Forestry and Environmental Resources Department with a minor in Human Dimensions of Natural Resources at North Carolina State University under the supervision of Dr. M. Nils Peterson and Dr. Lincoln R. Larson.

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Introduction

Chronic wasting disease (CWD) is a prion-based disease that affects family Cervidae, which includes wildlife such as white-tailed deer (*Odocoileus virginianus),* Rocky Mountain elk (*Cervus elaphus nelsoni*), and moose (*Alces alces*). Symptoms of CWD include a loss of coordination, abnormal behavior, emaciation, and ultimately death for all infected animals (Belay et al., 2004; Miller and Vaske, 2022). Chronic wasting disease is equivalent to mad cow disease, scrapie in sheep, and Creutzfeldt-Jakob disease in humans (Gross and Miller, 2001; McKintosh et al., 2003). It was first detected among captive deer in Colorado in 1967 (Vaske, 2010) and free-ranging deer in Colorado in 1981 (Spraker et al., 1997) and has continued to expand globally. As of March 2023, 29 states in the United States and other countries such as South Korea, Sweden, and Norway had reported cases of CWD in free ranging cervids (Centers for Disease Control and Prevention, 2022). There is no vaccination to protect herds and no cure for the disease (Robinson et al., 2012). Although there is not currently evidence showing that CWD poses a risk to human health, transmission to humans might be possible (Swire and Colchester, 2023; Saunders et al., 2012).

The World Health Organization recognizes zoonotic diseases as a global concern for human health, with potential for significant economic impacts (Thulin et al., 2015). Those economic impacts might be particularly consequential in the case of CWD. CWD is a costly disease to manage because wildlife agencies have to provide financial support to increase surveillance and security of highly-impacted areas (Rivera et al., 2019), compensate for sample testing (Carlson, 2018), and pay for the depopulation of captive cervid facilities (Bureau, 2006). Furthermore, hunting participation has decreased as a result of CWD emergence in some locations (Bishop, 2004; Heberlein, 2004; Vaske et al., 2004b). Less hunting reduces wildlife agencies' revenues from license sales that support operating costs (Fix et al., 1998; Mehmood et al., 2003; Miller and Vaske, 2003) and herd management. Thus, in addition to affecting cervid populations, CWD has the potential to severely impact the culture, tradition and social and economic stability of the communities that depend on white-tailed deer hunting (Needham et al., 2004; Bishop, 2004; Heberlein, 2004).

Although enhanced understanding of disease biology is key, successful management of CWD ultimately hinges on human - and specifically hunters' - behavior (Vaske, 2010). Successful CWD management may require hunters to both support or carry out an array of practices including testing, following disposal requirements, baiting bans, increasing deer harvest, and targeted removal of deer from high impact areas (Cooney and Holsman, 2010; Meeks et al., 2022). Ongoing human dimensions of CWD research suggests hunter willingness to support CWD management depends on a diverse array of factors ranging from risk perception of the disease to levels of concern about the disease (Meeks et al., 2022). These studies suggest higher CWD prevalence may encourage hunters to accept more management interventions, but reduce willingness among hunters to carry out the needed interventions themselves (Vaske and Lyon, 2011). Though the demographic attributes of hunters have been studied in the context of human dimensions work on CWD, there is one element in particular that has not been considered: political identity. The COVID-19 pandemic elicited politicized public responses to public health efforts, and may have rendered zoonotic disease management both more relevant and more politically charged than ever before (Mukhtar, 2021; Calvillo et al., 2020). Given recent shifts in the political landscape within the United States and around the world, political identity represents an underexplored but potentially impactful driver of hunters' support for CWD management.

Another critical component of management for disease control is how to pay for it. With limited public funding available for management, policy makers and management officials need to be able to justify and encourage public investment in wildlife disease mitigation. Non-market valuation tools have proven critical in efforts to both estimate costs of effectively managing wildlife diseases (Bennett and Balcombe, 2012; Tait et al., 2017), and assessing potential economic support for management among key stakeholder groups (Ufer et al., 2022; Smith et al., 2019), and can serve as a critical tool in management and decision-making. Non-market valuation allows for the estimation of values people place on ecosystem goods and services for which there are no market prices (Manero et al., 2022). One of the challenges in managing wildlife disease is the lack of measurable transactions; however, the application of nonmarket valuation methods can assist with placing an economic value on mitigating impacts of

wildlife diseases. Contingent valuation (CV) may be the most frequently used non-market valuation tool for estimating the costs and benefits of wildlife disease management (Elkstrand and Loomis, 1997). Contingent valuation is a stated preference (survey) method in which respondents are asked to state their preferences in hypothetical or contingent markets that allows analysts to estimate demands for goods or services that are not traded in markets, and it is widely used in cost-benefit analysis and environmental impact assessment (Markandya and Ortiz, 2011; Carson and Hanemann, 2005; Venkatachalam, 2004). Contingent valuation approaches form the core of economic valuation studies investigating zoonotic disease management because they reveal important patterns in the public's willingness to pay (WTP) for solutions. Willingness to pay can be interpreted as the monetary measure of how much the good or service is worth to individuals. The CV approaches used in many wildlife disease economics studies may, however, be vulnerable to biases. For example, the mode of data collection and type of CV method applied can introduce important limitations.

In this study, we built on previous social science research with a case study exploring the relative importance of political identity in hunters' perception of CWD (Thesis Chapter 1) and by comparing estimates of WTP for CWD testing and carcass disposal derived from two types of survey modes (online and phone) and CV methodologies (open-ended and dichotomous choice questions; Thesis Chapter 2). Data for this project was collected among adult, white-tailed deer hunters in North Carolina and South Carolina, USA. The CWD management context represents an important framework for understanding hunters' opinion of this disease due to their integral role in wildlife management.

CHAPTER 1: Political Identity as a Driver of Hunter Responses to CWD in a post-COVID World

Catherine Sam Lerose

In collaboration with M. Nils Peterson, Lincoln R. Larson, Jay F. Levine, Moriah Boggess, Cristina Watkins, Joseph Fuller, Jonathan Shaw, Christopher Kreh, and Bradley Howard

Abstract

Chronic wasting disease (CWD), which impacts deer and other cervid populations, has emerged as a major wildlife management challenge throughout North America. Human dimensions of CWD management are critical because hunters and the public shape the political viability of management activities and impact disease spread/transmission with their behaviors. Recent political trends, fueled in part by events linked to the COVID-19 pandemic, may have fundamentally altered the social landscape for zoonotic disease management (including CWD). Within this context, we explored associations between political identity, perceived risk, concern, intended behavior, and management preferences for CWD among deer hunters in North Carolina and South Carolina (n=1430) during 2022. Compared to moderate and liberal hunters, conservative deer hunters reported lower average risk perceptions, lower concern about risk to themselves and the people that they know, a greater likelihood of hunting in an area after CWD was detected, and lower acceptance of all management actions designed to limit the spread of CWD. Regression models that accounted for other demographic and psychological variables suggested political identity was consistently among the most influential predictors of responses to CWD. A right-leaning political identity predicted hunters' stronger intent to hunt even if CWD was detected in their preferred hunting area and lower acceptance of disease management actions. These results build on previous research by providing preliminary evidence that political identity may shape how hunters perceive and respond to CWD and its management. Future research is needed to ascertain the degree to which political factors influence other aspects of wildlife disease management.

Introduction

Chronic wasting disease (CWD) has emerged as a central wildlife management challenge throughout North America. The disease is associated with a prion found in the central nervous system of family Cervidae, including white-tailed deer (*Odocoileus virginianus),* Rocky Mountain elk (*Cervus elaphus nelsoni*), and moose (*Alces alces*). Symptoms of CWD include a loss of coordination, unusual behavior, emaciation, and ultimately death for all infected animals (Belay et al., 2004; Miller and Vaske, 2022). Chronic wasting disease is analogous to mad cow disease, scrapie in sheep, and Creutzfeldt-Jakob disease in humans (Gross and Miller, 2001; McKintosh, Tabrizi, and Collinge, 2003). It was first detected among captive deer in the 1960s (Vaske 2010) and free-ranging deer in Colorado in the 1980s (Spraker et al., 1997) and has continued to expand globally. Infection rates for CWD among free ranging white-tailed deer and mule deer range from 25-70%, and may reach up to approximately 80% in captive herds (Regina Gun Safety and Licensing; Centers for Disease Control and Prevention, *Chronic wasting disease active*). As of June 2022, 29 states in the United States and other countries such as South Korea, Sweden, and Norway had reported cases of CWD in free ranging cervids (Centers for Disease Control and Prevention, 2022). There is no vaccination to protect herds and no cure for the disease (Robinson et al., 2012). Although there is not currently evidence showing that CWD poses a risk to human health, transmission to humans might be possible (Swire and Colchester, 2023; Saunders et al., 2012). Hunting participation has decreased as a result of CWD emergence in some locations (Bishop, 2004; Heberlein, 2004; Vaske et al., 2004b). Less hunting reduces wildlife agencies' revenues from license sales that support operating costs (Fix et al., 1998; Mehmood et al., 2003; Miller and Vaske, 2023) and herd management. Declining hunting participation due to CWD could also erode public support for wildlife agencies and their ability to manage natural resources (Fulton and Hundertmark, 2004; Miller and Vaske, 2003). With increased fear of CWD, hunters might substitute deer hunting with alternative types of hunting (e.g., different game species, different locations), which could increase pressure on different hunted species and areas (Vaske et al., 1990). Thus, in addition to affecting cervid populations, CWD has the potential to severely impact the culture, tradition and social

and economic stability of the communities that depend on white-tailed deer hunting (Needham et al., 2004; Bishop, 2004; Heberlein, 2004).

Although enhanced understanding of disease biology is key, successful management of CWD ultimately hinges on human - and specifically hunter - behavior (Vaske, 2010). Successful CWD management may require hunters to both support or carry out an array of practices including testing, stringent disposal requirements, baiting bans, increasing deer harvest, and targeted removal of deer from high impact areas (Cooney and Holsman, 2010; Meeks et al., 2022). Ongoing human dimensions of CWD research suggests hunter willingness to support CWD management depends on a diverse array of factors ranging from risk perception of the disease to levels of concern about the disease. For instance, hunters are more likely to support testing and herd reductions if they perceive a higher risk of CWD (Cooney and Holsman, 2010). Hunters' risk perceptions of CWD increases as disease prevalence rises (Lyon and Vaske, 2010). Up to half of the decline in deer hunting that has happened since the detection of CWD in Wisconsin may be attributable to concerns about health risks to humans (Vaske, 2010). An increase in CWD prevalence also leads to increases in hunters' support for management and reductions in their hunting participation rates (Needham et al., 2017). When CWD prevalence rates are at 10%, hunters aren't accepting of lethal control measures and only 5% of hunters report that they would stop hunting deer or elk in their state; however, hunters deem lethal action by agency staff to be acceptable at a 50% prevalence rate and 49% of hunters indicate that they would quit hunting under these conditions (Needham et al., 2004, 2006). Such studies suggest higher CWD prevalence may encourage hunters to accept more management interventions, but reduce willingness among hunters to carry out the needed interventions themselves.

Other cognitive variables, such as knowledge and value orientations, predict hunters' intended response to CWD and support for policy interventions (Harper et al. 2015; Needham et al., 2004; Needham and Vaske, 2008; Pattison-Williams et al., 2020; Schroeder et al., 2020). Improving hunters' knowledge about CWD may increase their compliance with recommended practices and regulations designed to reduce CWD prevalence and transmission (Vaske et al. 2022). Wildlife value orientations can also affect human behavior toward wildlife and an individual's/group's justification for their treatment and control of wildlife

(Deruiter, 2002; Manfredo et al., 2009). Wildlife value orientations are the pattern of direction and intensity among a set of basic beliefs regarding wildlife and provide organization among the broad spectrum of beliefs, attitudes, and behaviors regarding wildlife (Fulton et al., 1996; Schwartz, 2006). Different types of value orientations can affect acceptance of management interventions (Whittaker et al. 2006; Kansky et al., 2016; Sponarski et al., 2015; Hermann et al., 2013; Jacobs et al., 2014), many of which affect CWD prevention. For example, a person with a strong utilitarian orientation is more likely to prioritize human welfare over wildlife and view the killing of animals through activities such as hunting as acceptable (Gamborg and Jensen, 2016). On the other hand, a person with a strong mutualistic orientation is not as likely to support management strategies such as lethal removal of wildlife compared to those with domination-type tendencies (Manfredo et al. 2020).

Demographic variables typically have little impact on CWD management preferences or intended behaviors (Needham et al., 2006). Education and gender may influence hunter perceptions of CWD management and behaviors: individuals with higher education tend to have lower risk perceptions (Hanisch-Kirkbride et al., 2013; Sjoberg, 2004) and men are typically less concerned about risks than women (Kellert and Berry, 1987; Slovic, 2000). Other demographic characteristics of hunters including household size, age, income, and land ownership are rarely associated with CWD management preferences (Meeks et al. 2022).

Although previous research has tested the effects of some demographic attributes of hunters on their perception towards wildlife disease, political identity is often overlooked. Given recent shifts in the political landscape within the United States and around the world, political identity represents an underexplored but potentially impactful driver of hunters' support for CWD management. In recent years, particularly post-2020, there has been a rise in populist movements worldwide (Mauk, 2020). These movements have driven fragmentation of party systems, emergence of radical parties, feelings of anti-establishment, distrust of elite groups, and white nationalism (Edelman, 2020; Europe and Mudde, 2007). Political identity has become a central factor in how citizens evaluate a myriad of wide-ranging topics, including those that might appear to be apolitical in nature (e.g., the value of education) (Kaplan et al.,

2016). Within conservation, this shift has fomented declines in trust and a loss of faith in the government and other management authorities (Manfredo et al. 2017, 2020). The growing importance of political identity as a driver of wildlife management preferences has become more evident in natural resource conservation since the early 2000s (Manfredo et al. 2017; Haggerty 2007; Casola et al. 2022; van Eeden et al., 2021). Organizations such as the Alabama Wilderness Alliance (AWA) have formed to speak against environmental groups that they deem as liberal elites (Walton and Bailey, 2005). People in the western region of the United States have also rejected government intervention for climate change mitigation, protection of gray wolves, and governance of resource extraction due to its infringement on individual land rights and collective identities of independence (Putsche et al., 2017). Similar populist pushback has emerged among some hunting groups in response to perceptions of undue influence by urban elites who are often non-hunters with different values (McCorquodale 1997; Manfredo et al., 2017; Boglioli, 2009; Manfredo et al., 2017).

This wave of political populism, when influenced by the COVID-19 pandemic, may have reshaped public perceptions of zoonotic disease management (Beall et al., 2021; Casola et al., 2022). The COVID-19 pandemic elicited surprisingly politicized public responses to public health efforts, and may have rendered zoonotic disease management both more relevant and more politically charged than ever before (Mukhtar 2021; Calvillo et al., 2020). The causative agent of COVID-19 (SARS-CoV-2) has been found in other hosts besides humans, such as white-tailed deer (Gao and Wang, 2021; Palmer et al., 2021). Since there are direct links between COVID-19 and wildlife (Chakraborty and Maity, 2020; Le Page, 2021; Palmer et al., 2021), COVID-19 made wildlife disease risk management more salient (Bonilla-Aldana, 2020). In the United States, political identity was one of the defining traits that appeared to be associated with how a person perceived COVID-19 management (Beall et al., 2021; Bruine de Bruin 2020; Casola et al., 2022; Green et al., 2020; Shao and Hao, 2020). For example, people with a conservative political identity often resisted regulations given by public health experts prescribed to reduce the spread of COVID-19 (e.g., refusing to wear a mask or get vaccinated) (Haischer et al., 2020; Hao et al., 2021; Malik et al., 2020; Kerr et al., 2021; Barrios and Hochberg, 2020). Politicized responses to disease spread could partially

be explained by cultural cognition of risk theory, which posits that pre-established beliefs serve as filters shaping learning, risk perception, and behavior (Kahan 2008; Kahan et al. 2011; Beall et al. 2021). Since wildlife-related risk perceptions often reflect personal values, judgment of hazard, and societal norms (Triezenberg et al., 2014), it is not surprising that they might be impacted by political identity. For example, liberals who perceived greater risk from COVID-19, were more likely to believe in a wildlife origin of COVID-19, and were more likely to support restrictions on wildlife trade than conservatives (Beall et al., 2021). The growing influence of political identities and populism in the post-pandemic era calls for more research on how these factors impact the management context for wildlife diseases such as CWD.

In this study, we built on previous social science research with a case study exploring the relative importance of political identity in models of CWD risk perception, concern, intended hunting behavior, and support for CWD management among white-tailed deer hunters in North and South Carolina, USA. We tested four hypotheses regarding the role of political identity in perceptions of CWD: (1) liberals/moderates perceive higher risk of CWD than conservatives, (2) liberals/moderates report higher levels of concern regarding CWD than conservatives, (3) conservatives are more likely to continue hunting as the prevalence of CWD rises, and (4) liberals/moderates are more likely to support agency's CWD management strategies than conservatives. These hypotheses are all based on the assumption that cultural cognitions, shaped by political identity, strongly influence the way people think and act about disease risk management.

Methods

Sampling & Data Collection

Our study of hunters' perspectives regarding CWD focused on two southeastern states: North Carolina (a state where the disease was recently detected in 2022) and South Carolina (a state where the disease has not yet been detected). In North Carolina, we administered our survey to a simple random sample of 8,490 adult (age 18 years or older) North Carolina hunters who were licensed to hunt white-tailed deer between 2018 and 2020. Most (n=5,178) had email addresses and received invitations to take an online Qualtrics survey in March of 2022. Participants contacted via email, were sent one invitation and three

reminders, each sent a week apart (Dillman et al., 2014). We deleted records for those who requested to be removed from the contact list (n = 9). The remaining hunters were mailed postcards (n=3,312) with a link and a QR code to the online survey. We mailed three postcard reminders at two week intervals. After removing 126 incorrect addresses, we received 727 responses, 600 of which were fully completed. This resulted in a response rate of 8.6%, with 526 responses coming from email recruitment and 201 responses coming from postcard recruitment.

In South Carolina, we administered a survey to a simple random sample of 10,000 adult (age 18 years or older) South Carolina hunters who were licensed to hunt white-tailed deer in 2022. We sent them email invitations to take an online Qualtrics survey in October 2022. The email contained a link to the online survey. Similar to the North Carolina survey, we sent one invitation email and three reminder emails, each sent a week apart. We deleted records of those who asked to be removed from the contact list for this study (n = 7). We received a total of 703 responses from the email recruitment, for an online survey response rate of 7.03%.

To test for potential non-response bias and augment our online survey samples in both states, we conducted phone interviews with people who had not responded to the requests to complete the online survey. The phone-based questionnaire used a subset of the questions from the online instrument that included the primary constructs we wanted to study (e.g., CWD risk perception, management preferences). For North Carolina, participants for the phone calls were randomly selected from the non-respondents to the online survey. For South Carolina, participants for the phone calls were randomly selected from a list of hunters who did not respond to the online survey (n = 8,000) and hunters who did not have an email address on file (n = 230). We surveyed 303 participants via phone from North Carolina, with a compliance rate of 50.8%. We defined compliance rate as the proportion of people from the sample frame who answered questions after answering the phone. Our research partner Southwick Associates surveyed 300 participants via phone from South Carolina, and did not measure compliance rate. This study was approved by the Human Subjects Institutional Review Board of North Carolina State University (protocol #24355).

Questionnaire Development

We consulted with NC Wildlife Resources Commission biologists to ensure that questionnaire language and content was factually correct. We pretested the questionnaire with 200 randomly selected hunters from the same population as the survey, 121 of whom received an email link and 79 of whom received a postcard to complete our survey. Then, we conducted cognitive interviews with 10 additional hunters (Desimone and Le Floch, 2004; Peterson et al., 2017; Casola et al., 2020; Valdez et al., 2018) whom we knew through personal acquaintances (graduate students, faculty, etc.). These interviews included discussing each question with participants to iteratively improve alignment between the research team's intended meaning of questions and interpretations of question meaning among the participants (Casola et al., 2020). We asked the participant to voice their inner monologue as they completed the questionnaire and to identify and correct issues associated with wording, question comprehension, and skip patterns (Dalrymple et al., 2010; Burke et al., 2019).

We assessed five main constructs in the survey instrument: 1. Knowledge of CWD, 2. Risk perception of CWD, 3. Concern about CWD, 4. Impacts on hunting behavior in CWD-impacted areas, and 5. Acceptance of various CWD management activities. Several scales were adapted from prior literature (**Table 1.1.**). We used a five item knowledge scale (true, false, or unsure) adapted from Vaske et al. (2022) to measure hunter's knowledge of CWD disease ecology. We used a 9-point Likert scale from not a risk/not concerned to extreme risk/extremely concerned, adopted from Needham et al., (2017), to measure perceived risk of CWD and level of concern for humans and wildlife. We included a hypothetical scenario in our online survey related to CWD prevalence: "Imagine about 1 out of 10 deer (10%) have CWD in the county where you most often hunt deer". To measure behavioral intentions in response to CWD, hunters evaluated each scenario and indicated: (a) "I would hunt more", (b) "My hunting wouldn't change", (c) "I would hunt less", (d) "I would completely stop hunting" (adapted from Needham et al. 2004). We measured hunters' acceptance of decreasing the populations of the overall deer herd, decreasing the number of mature bucks, the agency to "do nothing", and the agency to enact each of four actions-items: require unused deer parts to be buried/incinerated/disposed of in a landfill, require all hunters to provide a sample for testing, ban

supplemental feeding and baiting of deer, and ban the removal of deer skulls and spinal cords from the location where the deer was harvested (Needham et al. 2004; Poudyal 2022; Schroeder 2021). We used a 5-point Likert scale from completely unacceptable to completely acceptable, adopted from Poudyal (2022), to assess respondents' acceptance of these items.

Political identity was assessed using a 5-point scale ranging from very conservative to very liberal (adapted from Casola et al., 2020; Beall et al., 2021). The questionnaire also asked respondents to report other socio-demographic attributes including gender (asked as 'Male', 'Female', or 'Other' with a box for them to specify if they chose to do so), age (asked as "What year were you born?"), education (asked on a 4-point scale from Less than a high school diploma to Advanced degree beyond a 4-year degree), and income (from Less than $10,000 to $150,000 or more).

Table 1.1. Means, standard deviations, and Cronbach's Alpha for items and scales measuring hunter perceptions of CWD in North and South Carolina (n = 1,430).

Scale and Item Description	Mean	SD	Cronbach's alpha
Risk Perception	2.91	1.74	0.77
How much risk do you think is associated with each of the following happening to YOU?[a]			
RISK 1: Accidentally eating meat from an animal infected with CWD	3.18	2.00	–
RISK 2: Becoming ill as a result of exposure to CWD	2.65	1.87	–
Concern for People	3.41	2.32	0.95
How concerned are YOU about each of the following issues now that Chronic Wasting Disease has been detected in Virginia near the NC border?[b]			
CONCERN 1: Your own personal health	3.33	2.35	–
CONCERN 2: The health of other people you know	3.50	2.41	–
Concern for Deer Populations and Hunting	6.11	2.33	0.93
How concerned are YOU about each of the following issues now that Chronic Wasting Disease has been detected in Virginia near the NC border?[b]			
CONCERN 1: The potential for CWD to dramatically reduce the deer population in North/South Carolina?	5.90	2.47	–
CONCERN 2: The threat CWD poses to the future of deer hunting in North/South Carolina	6.32	2.35	–
Intended Hunting Behavior			
Imagine about 1 out of 10 deer (10%) have CWD in the county where you most often hunt deer. How would your hunting participation in that county change?[c]	0.55	0.50	–
Acceptance of Decreasing Deer Populations	0.31	1.20	0.85
Please indicate how acceptable the following management changes would be to slow the spread of the disease in your main deer hunting county.[d]			
ITEM 1: Significantly decreasing the overall deer population	0.48	1.24	–
ITEM 2: Significantly decreasing the overall number of mature bucks	0.15	1.33	–

Table 1.1. (continued).

Management Acceptance			
Please indicate how acceptable the following actions or requirements would be if CWD was detected in North Carolina.[d]			
MANAGEMENT 1: Do nothing, and let nature take its course	-0.72	1.18	–
Acceptance of CWD Management Interventions	0.46	0.91	0.66
Please indicate how acceptable the following actions or requirements would be since CWD has been detected in North Carolina.[d]			
MANAGEMENT 2: Require unused deer parts to be buried, incinerated, or disposed of in a landfill	1.00	1.11	–
MANAGEMENT 3: Require all hunters to provide a sample for testing	0.72	1.20	–
MANAGEMENT 4: Ban supplemental feeding and baiting of deer	-0.03	1.42	–
MANAGEMENT 5: Ban removal of deer skulls and spinal cords from the location where the deer was harvested	0.13	1.38	–

[a]*Likert scale 1 = "No Risk" to 9 = "Extreme Risk".*
[b]*Likert scale 1 = "Not Concerned" to 9 = "Extremely Concerned".*
[c]*Recoded to 0 = "I would completely stop hunting" or "I would hunt less" vs. 1 = "My hunting wouldn't change" or "I would hunt more".*
[d]*Recoded to -2 = "Completely Unacceptable" to 2 = "Completely Acceptable".*

CWD emerged in North Carolina after 343 responses were recorded, requiring us to change wording for two questions. First, we changed the question stem for the concern table by replacing "How concerned are YOU about each of the following issues now that Chronic Wasting Disease has been detected in Virginia near the NC border?" with "How concerned are YOU about each of the following issues now that Chronic Wasting Disease has been detected in North Carolina near the Virginia border?" Second, we changed the question stem for the support for reducing deer numbers table by replacing "Please indicate how acceptable the following actions or requirements would be if CWD was detected in North Carolina." with "Please indicate how acceptable the following actions or requirements would be since CWD has been detected in North Carolina." (**Table 1.1.**).

Data Analysis

A principal components factor analysis (PCA) with orthogonal (Varimax) rotation was employed to assess the structure of the Likert-type items, evaluate construct validity, and summarize multiple survey scales into latent constructs (Meeks et al., 2022; Smith et al., 2021). Internal consistency and reliability of constructs were assessed for each scale with the cutoff Cronbach's alpha >0.6 (Bland and Altman, 1997). All of our factor loadings were > 0.65, indicating a relatively strong relationship between individual items and the latent constructs they measured (Shevlin and Miles, 1998). Factor analysis results supported the four hypothesized constructs of interest in CWD including "Risk Perception" (2 items, factor loadings $\geq$ 0.903, Cronbach's alpha = 0.77, **Table 1.1.**), two dimensions of concern about CWD including "Concern for People" (2 items, factor loadings $\geq$ 0.951, Cronbach's alpha = 0.95; **Table 1.1.**) and "Concern for Deer Populations and Hunting" (2 items, factor loadings $\geq$ 0.941, Cronbach's alpha = 0.93; **Table 1.1.**), "Acceptance of Decreasing Deer Populations" (2 items, factor loadings = 0.934, Cronbach's alpha = 0.85; **Table 1.1.**), and "Acceptance of CWD Management Intervention" (4 items, factor loadings > 0.65, Cronbach's alpha = 0.66). We retained the "do nothing" for management option as a separate, stand-alone variable because it did not load on the "Acceptance of CWD Management" factor (even when reverse-coded) and it inherently contradicted the other action-items (**Table 1.1.**). See **Supplemental File A** for detailed methodology and results. After confirming factor structure, we combined items and calculated a mean score for each respondent for all relevant latent constructs (Smith et al., 2021).

Responses for our true/false questions were coded as either incorrect (0) or correct (1); unsure was categorized as incorrect. A knowledge index was created by summing the five knowledge questions (range = 0 to 5). For our hypothetical scenario, the first two responses were collapsed into a single category labeled "Increase hunting/no change" and the last two responses were collapsed into a single category labeled "Decrease hunting/stop hunting".

After measuring scale properties and calculating index scores for multi-item constructs (**Supplemental File A**), we examined descriptive statistics (e.g., counts, averages, standard deviations, and percent frequencies) for the following variables: risk perceptions related to CWD, concern related to CWD,

future hunting behavior in a hypothetical scenario, and management acceptance for CWD. Then, we compared the means among conservatives compared to moderates/liberals for all of these items using independent samples t-tests to determine which group was more willing to view CWD as a risk (Hypothesis 1), view CWD as a concern (Hypothesis 2), report a higher likelihood of increasing hunting behavior at hypothetical CWD prevalence levels (Hypothesis 3), and support CWD management (Hypothesis 4). To minimize the likelihood of Type 2 errors (false positives) when interpreting results of our multiple hypothesis tests, we applied a Holm-Bonferroni correction (Abdi, 2010) to adjust the threshold of statistical significance. We measured effect size using Cohen's *D* (Haus et al., 2017).

We assigned each participant to one of two categories - conservatives or moderates/liberals. The group labeled conservatives encompassed those who indicated they were Very Conservative or Somewhat Conservative on the questionnaire (77% of the sample). The moderates/liberals group included those who selected that they were Very Liberal, Somewhat Liberal, or Moderate on the questionnaire (23%). These percentage breakdowns of political identity are a little different than the general populations of North Carolina (Conservatives: 40%, Moderate: 32%, Liberal: 23%, Unknown: 5%; Pew Research Center, 2022) and South Carolina (Conservatives: 43%, Moderate: 35%, Liberal: 15%, Unknown: 6%; Pew Research Center, 2022). However, hunters traditionally lean conservative or Republican on the political identity spectrum (Yamane et al., 2021). We combined moderate and liberal hunters to make the comparisons among political groups more balanced. We decided that this was justified since only 4% of our sample identified as politically liberal. Furthermore, we tested for differences between moderate hunters and liberal hunters using t-tests to detect differences in averages. We used Cohen's *D* to assess their effect sizes (Haus et al., 2017).

Differences in average results between hunters in North Carolina who completed the questionnaire before CWD was detected in the state and afterwards were tested for using t-tests. Again, we used Cohen's *D* to assess effect sizes (Haus et al., 2017).

In order to compare responses across states and control for the state variable in analyses, we combined the datasets that we obtained from North Carolina and South Carolina. However, we retained a

variable in our dataset and analysis (1 for NC, 0 for SC) to account for any inter-state differences. We used binary logistic regression to examine the association between political identity and the intended hunting behavior if 10% of deer in hunters' main deer hunting zone had CWD (Hypothesis 3), and we used linear regression models to examine associations between political identity and two dependent variables: (1) acceptance of the agency to "Do nothing, and let nature take its course" and (2) acceptance rating for the aggregate CWD management scale (Hypothesis 4). These models controlled for hunters' knowledge about CWD, which was coded as a dummy variable (with those who answered at least three true/false questions correctly as 1 and those who didn't as 0), risk perception (measured on a scale from 1-9), concern for people (measured on a scale from 1-9), and concern for deer populations and hunting (measured on a scale from 1-9). The demographic attributes controlled for included gender, which was coded as a dummy variable (with males as 1 and females/other as 0), age (treated as a continuous variable, representing participants' ages ranging from 18 to 88), education level (which was coded as a dummy variable with college-educated being 1 and non-college-educated being 0), and state (with North Carolina being 1 and South Carolina being 0). Prior to interpreting models, we tested for assumptions of multicollinearity in our regression models using variance inflation factors (VIFs) (Craney and Surles, 2002). The VIF values for all four regression models were below 2.0, thereby low enough to deduce minimal collinearity among the predictors. We reported X-standardized odds ratios (Chen et al., 2013) representing the effects of a standard deviation change of the independent variables to facilitate direct comparisons between them (Long and Freese, 2006). We compared parameter estimates and odds ratios to identify variables associated with each dependent variable. Wherever possible, we used pairwise exclusion for missing values to maximum use of available information in analyses.

Finally, we tested for non-response bias in our sample by comparing the data we obtained from our online survey with the data we obtained from our phone survey using independent samples t-tests for numerical data (Lawson et al., 2019) and chi-square tests for categorical data (Etter and Perneger, 1997; Reisenwitz, 2016). Our phone sample was younger than the online survey sample (mean age 46 vs. 54, $t(1850) = 10.89$, $p < 0.001$), slightly more likely to be female (6.2% vs. 6.0%, $X^2(1,1875) = 0.024$, $p =$

0.876), and less likely to have obtained a college degree (66.1% college degree vs. 74.9%, $X^2(1,1849) = 15.252$, $p < 0.001$). Despite significant differences, all of the effect sizes for these relationships were small (i.e., below the 0.6 threshold for medium effect size for Cohen's *D* for t-tests (Lovakov and Agadullina, 2021) and below the 0.1 threshold for Phi for chi-square tests (Kotrlik et al., 2011), thus we decided that weighting was not necessary. For our psychological variables, most differences between our online survey and phone survey were not significant. For the differences that were significant (i.e., acceptance of the state agency doing nothing, acceptance of significantly decreasing the overall deer population and number of mature bucks), effect sizes were small (< 0.6; Lovakov and Agadullina, 2021). We conducted analyses using SPSS Statistics (IBM Corp).

Results

Demographic statistics within our online sample reflected those of typical hunters in North and South Carolina (**Table 1.2.**). A majority of respondents (94%) were male, and ages within the sample ranged from 18-88 ($M = 54.1$, $SD = 14.7$). Most respondents reported a college degree (2-year Associate's degree or 4-year college degree) or higher (75%). Most participants (77.4%) reported being politically conservative.

Most of the differences among demographic and psychological variables were insignificant between conservative and moderate/liberal hunters (p-value was > 0.05 for t-tests). The only two variables that significantly differed between these two groups of hunters was education and gender (both p-values < 0.05). Although the Cohen's *D* values for these differences were 0.41 and -0.30 respectively, we decided that we can combine moderates and liberals since most differences were insignificant. Also, most differences were insignificant between North Carolina hunters pre and post-detection; however, differences in risk perception and acceptance of "do nothing and let nature take its course" were significant ($p = 0.03$ for both). However, the effect sizes for these differences were small (Cohen's $D < 0.10$ for both). Therefore, we decided that differences in hunters' perceptions of CWD across detection status were not important for this study.

Table 1.2. Breakdown of Percentages of North and South Carolina Hunters in Largest Group for Gender[a], Education Level[b], and Political Identity[c] and Average Age[d] by Survey Type and State using Descriptive Statistics.

	Percentage	**Average Age (SD)**
NC Online		
Male	94.6	N/A
College-educated	69.2	N/A
Conservative	74.6	N/A
Age	N/A	54.9 (15.2)
SC Online		
Male	93.1	N/A
College-educated	79.7	N/A
Conservative	79.8	N/A
Age	N/A	53.4 (14.2)
NC + SC Online		
Male	93.8	N/A
College-educated	74.9	N/A
Conservative	77.4	N/A
Age	N/A	54.1 (14.7)
NC Phone		
Male	93.5	N/A
College-educated	67.1	N/A
Conservative	N/A	N/A
Age	N/A	45.5 (16.3)
SC Phone		
Male	94.2	N/A
College-educated	65.1	N/A
Conservative	N/A	N/A
Age	N/A	46.3 (14.2)

Table 1.2. (continued).

NC + SC Phone		
Male	93.8	N/A
College-educated	66.1	N/A
Conservative	N/A	N/A
Age	N/A	45.9 (15.3)
NC + SC, Online + Phone		
Male	93.8	N/A
College-educated	74.9	N/A
Conservative	N/A	N/A
Age	N/A	51.5 (15.3)

[a]*Coded as: 1 = Male, 0 = Female, -1 = Other*
[b]*Coded as: 1 = College-Education, 0 = Not College-Educated*
[c]*Coded as: 1= Conservative, 0 = Moderate/Liberal*
[d]*Treated as a continuous variable*

We found support for hypotheses 1-4. Compared to conservatives, moderates/liberals were significantly more likely to report higher risk perceptions related to CWD ($t(1216) = 3.16$, $p = 0.002$, Cohen's $D = 0.22$) and greater concerns for people ($t(1229) = 2.10$, $p = 0.036$, Cohen's $D = 0.14$). However, concerns among political groups regarding deer populations and hunting were similar ($t(1230) = -0.40$, $p = 0.69$, Cohen's $D = -0.03$; **Table 1.3.**).

Conservatives reported a greater likelihood of maintaining or increasing their hunting participation in a CWD-affected area ($t(1233) = -3.00$, $p = 0.003$, Cohen's $D = -0.21$). Regression models examining hunting behavior change in response to CWD mirrored mean comparison results (**Table 1.3.**) and supported hypothesis 3. Even when controlling for a variety of other demographic and psychological variables, hunters with a conservative political identity reported that their hunting participation levels would be more resilient to emergence of CWD in their primary hunting area (OR = 1.28, $p < 0.001$; **Table 1.4.**). Other variables also predicted changes in hunting behavior in response to CWD (**Table 1.4.**). Individuals who

were more concerned about the effects of CWD on human health were less likely to continue hunting (OR = 0.68, p = < 0.001). Younger hunters were more likely than older hunters to continue hunting in CWD-affected areas (OR = 0.61, p = < 0.001).

Moderate/liberal hunters reported a higher acceptance of decreasing deer populations (t(464) = 3.78, p = <0.001, Cohen's D = 0.26). Regression models examining management support in response to CWD mirrored mean comparison results (**Table 1.3.**) and supported hypothesis 4. Hunters who identified as moderate or liberal were more accepting of decreasing deer populations in comparison to conservative hunters (B = -0.12, p = < 0.001; **Table 1.6.**). Two other demographic variables besides political identity also predicted support for decreasing deer populations in response to CWD (**Table 1.6.**). Hunters who were older (B = 0.17, p < 0.001) and highly educated (B = 0.06, p = 0.05) were more likely to accept the decrease of deer populations. Political identity was consistently among the stronger predictors of hunting behavior and management support, even when accounting for other psychological variables (including knowledge, risk perceptions, and concern) and demographic variables (including age and education; **Tables 1.4-6.**). Despite this, the predictive power of the future hunting behavior model (Nagelkerke pseudo-R^2 = 0.15), and the CWD management acceptance models (Adj. R^2 values between 0.06 and 0.11) were relatively weak, suggesting that many other variables beyond those considered in this study likely impact hunters' response to CWD and CWD-related interventions.

Moderate/liberal hunters also reported a lower acceptance of the agency doing nothing to limit the spread of CWD (t(1231) = -3.19, p = 0.001, Cohen's D = -0.22). Lastly, moderate/liberal hunters reported a higher acceptance of management interventions designed to stop the spread of CWD (t(1232) = 5.04, p < 0.001, Cohen's D = 0.34) (**Table 1.3.**). With respect to support for CWD management, conservative hunters were more accepting of doing nothing to address CWD emergence (B = 0.12, p = < 0.001; **Table 1.5.**) and less likely to accept management intervention (B = -0.17, p = < 0.001; **Table 1.5.**). Other variables also predicted support for management in response to CWD (**Table 1.5.**). Hunters who were more concerned about the potential for CWD to reduce deer populations were more likely to accept management interventions (B = 0.19, p = < 0.001), and those who expressed more knowledge about the disease were

less likely to accept “do nothing” as an alternative (B = -0.07, p = 0.02). Hunters who were older (B = 0.15, p = < 0.001) and highly educated (B = 0.07, p = 0.01) were more likely to accept management intervention. Finally, hunters in North Carolina were less likely to accept CWD management interventions than hunters in South Carolina (B = -0.09, p = <0.001).

Table 1.3. Comparison of CWD Risk Perceptions[a], Concern[b,c], Future Hunting Behavior[d], Acceptance of Decreasing Deer Populations[e], Acceptance of Doing Nothing[f], and Acceptance of CWD Management Intervention[g] (Mean, SD, Percentage (%) that Scored High[h] on Response Scale) for Conservative and Moderate/Liberal Deer Hunters in North and South Carolina.

Variables	Conservatives (n = 957)			Moderates/Liberals (n = 279)			Overall sample (n = 1430)		t	Cohen's D
	M	*SD*	*%*	*M*	*SD*	*%*	*M*	*SD*		
Risk perception	2.84	1.72	3.3	3.21	1.79	4.0	2.91	1.74	3.16**	0.22
Concern for people	3.36	2.32	10.7	3.69	2.39	13.0	3.41	2.32	2.10*	0.14
Concern for deer populations and hunting[f]	6.19	2.29	46.7	6.13	2.34	45.5	6.11	2.33	-0.40	-0.03
Intended hunting behavior	0.58	0.49	57.9	0.48	0.50	47.7	0.55	0.50	-3.00**	-0.21
Acceptance of decreasing deer populations	0.25	1.21	48.3	0.56	1.17	55.9	0.31	1.20	3.78***	0.26
Acceptance of Do nothing and let nature take its course	-0.68	1.18	16.8	-0.94	1.14	12.2	-0.72	1.18	-3.19***	-0.22
Acceptance of CWD Management Interventions	0.40	0.89	62.3	0.71	0.87	74.6	0.46	0.91	5.04***	0.34

, **, * denote statistically significant p-values at alpha = 0.05, 0.01, and 0.001, respectively.*

[a]Risk perception overview: 2 items; Cronbach's alpha = 0.772; rated on a scale from 1 = No Risk to 9 = Extreme Risk; percentage is of those who scored > 7

[b]Concern for people overview: 2 items; Cronbach's alpha = 0.951; rated on a scale from 1 = Not Concerned to 9 = Extremely Concerned; percentage is of those who scored > 7

[c]Concern for deer populations and hunting overview: 2 items; Cronbach's alpha = 0.927; rated on a scale from 1 = Not Concerned to 9 = Extremely Concerned; percentage is of those who scored > 7

[d]Coded as either 0 = Stop hunting/Decrease hunting or 1 = No change/Increase hunting; percentage is of those who scored a 1

[e]Acceptance of decreasing deer populations overview: 2 items; Cronbach's alpha = 0.853; rated on a scale from -2 = Completely Unacceptable to 2 = Completely Acceptable; percentage is of those who scored > 0

[f]Acceptance of "Do Nothing" = Rated on a scale from -2 = Completely Unacceptable to 2 = Completely Acceptable; percentage is of those who scored > 0

[g]Acceptance of CWD management interventions overview: 4 items; Cronbach's alpha = 0.663; rated on a scale from -2 = Completely Unacceptable to 2 = Completely Acceptable; percentage is of those who scored > 0

[h]Percentage of participants who scored: >7 for risk perception, concern for people, and concern for deer populations and hunting, 1 for intended hunting behavior, >0 for acceptance of decreasing deer populations, acceptance of "Do Nothing", and acceptance of CWD management interventions

Table 1.4. Parameter estimation (*B*) and standardized odds ratios (OR) from a logistic regression model predicting future hunting participation[a] of hunters in North Carolina and South Carolina in CWD-affected areas (n = 1430)[b].

Variable	B	SE	Standardized OR	p-value
Constant	2.10	0.40		<0.001
Political identity	0.25	0.06	1.28	<0.001
Gender	0.43	0.26	1.53	0.097
Age	-0.50	0.07	0.61	<0.001
Education	-0.01	0.15	0.99	0.922
State	0.09	0.13	1.10	0.463
Knowledge level	0.25	0.13	1.28	0.053
Risk perception[c]	-0.03	0.07	0.97	0.698
Concern for people[d]	-0.38	0.08	0.68	<0.001
Concern for deer populations and hunting[d]	-0.11	0.07	0.90	0.128

, **, * denote statistically significant p-values at alpha = 0.05, 0.01, and 0.001, respectively.*

[a]Response options: "Increase hunting/no change" (coded as 1) and "Decrease hunting/stop hunting" (coded as 0)

[b]Cragg-Uhler (Nagelkerke) R^2 = 0.146

[c]Scale: 1 = No Risk to 9 = Extreme Risk

[d]Scale: 1 = Not Concerned to 9 = Extremely Concerned

Table 1.5. Parameter estimation from linear Regression Models Examining Factors Associated with North and South Carolina hunters' acceptance[a] of the CWD management option "Do nothing, and let nature take its course"[b] and acceptance of CWD Management Interventions (n = 1430)[c].

	Do nothing, and let nature take its course			***CWD Management Interventions***		
Variable	**B**	**SE**	**Standardized B**	**B**	**SE**	**Standardized B**
Constant	-0.30	0.21		-1.12	0.62	
Political identity	0.34	0.08	0.12***	-1.43	0.24	-0.17***
Gender	-0.03	0.14	-0.006	0.26	0.41	0.02
Age	-0.003	0.002	-0.04	0.04	0.007	0.15***
Education	-0.10	0.08	-0.04	0.59	0.23	0.07**
State	0.31	0.07	0.13***	-0.66	0.20	-0.09***
Knowledge level	-0.16	0.07	-0.07*	0.34	0.20	0.05
Risk perception[d]	0.002	0.02	0.003	-0.07	0.07	-0.04
Concern for people[e]	0.01	0.02	0.02	0.02	0.05	0.01
Concern for deer populations and hunting[e]	-0.08	0.02	-0.16***	0.29	0.05	0.19***

, **, * denote statistically significant p-values at alpha = 0.05, 0.01, and 0.001, respectively.*
[a]*Scale: -2 = Completely Unacceptable to 2 = Completely Acceptable*
[b]*Adjusted R^2 = 0.067*
[c]*Adjusted R^2 = 0.105*
[d]*Scale: 1 = No Risk to 9 = Extreme Risk*
[e]*Scale: 1 = Not Concerned to 9 = Extremely Concerned*

Table 1.6. Parameter estimation from a linear Regression Model Examining Factors Associated with North and South Carolina hunters' acceptance[a] of Decreasing Deer Populations (n = 1430)[b].

Variable	B	SE	Standardized B	p-value
Constant	-0.79	0.21		<0.001
Political identity	-0.16	0.04	-0.12	<0.001
Gender	0.26	0.14	0.05	0.06
Age	0.01	0.002	0.17	<0.001
Education	0.16	0.08	0.06	0.05
State	-0.08	0.07	-0.03	0.26
Knowledge level	0.11	0.07	0.05	0.12
Risk perception[c]	0.03	0.02	0.04	0.22
Concern for people[d]	0.02	0.02	0.04	0.23
Concern for deer populations and hunting[d]	0.004	0.02	0.007	0.82

[a]*Scale: -2 = Completely Unacceptable to 2 = Completely Acceptable*
[b]*Adjusted R^2 = 0.058*
[c]*Scale: 1 = No Risk to 9 = Extreme Risk*
[d]*Scale: 1 = Not Concerned to 9 = Extremely Concerned*

Discussion

This study contributed to human dimensions research on wildlife disease by documenting how political identity shaped hunters' perceptions of CWD risk, intended changes in hunting behavior related to the emergence of CWD, and support for management of CWD. Compared to conservative hunters, moderate and liberal hunters viewed CWD as a greater concern and an issue that requires agency intervention (whether it be decreasing the deer populations or implementing new bans/requirements). In contrast to other demographic and attitudinal variables with limited impact on CWD management preferences (e.g., age, income, gender; (Meeks et al., 2022), political identity tended to be among the most influential predictors. The politicized responses to CWD detected in this study appear similar to those associated with the COVID-19 pandemic (Beall et al., 2021). Specifically, people who identify as more

politically left leaning are generally more supportive of disease management, and less risk tolerant (Haischer et al., 2020; Hao et al., 2021; Malik et al., 2020; Kerr et al., 2021; Barrios and Hochberg, 2020).

Our results contribute to research on public responses towards wildlife disease by highlighting how cultural cognition may shape hunters' perceptions of CWD (Kahan et al., 2011). Cultural cognition among those with hierarchical and individualistic worldviews tends to downplay environmental risks because addressing those risks often requires collective action that threatens hierarchical social structures and restricts the free market (Kahan et al., 2008). In contrast, cultural cognition among those with egalitarian and communitarian worldviews promotes higher perceived risk for environmental issues and more support for environmental regulations, particularly those that reduce inequality within society (Douglas and Wildavsky, 1983; Kahan et al., 2008). Cultural cognition is closely tied to political ideology, particularly in the United States, where conservatives tend to adopt individualistic and hierarchical worldviews and liberals tend to adhere to communitarian and egalitarian ones (Wildavsky, 1987; Gastil et al., 2011; van der Linden, 2016). Political identity-related cultural cognition predicted how Americans evaluated the importance of conservation during the COVID-19 pandemic (Casola et al., 2022). These patterns are consistent with those observed before and leading up to the 2020 election, signifying that liberal voters tend to place significantly more weight on issues related to conservation and the environment than their conservative counterparts (Pew Research Center, 2020a; Casola et al., 2022). Furthermore, differing perceptions of COVID-19 risk driven by cultural cognition predicted more support for protective actions such as handwashing and social distancing among those identifying as more politically liberal (Bruine de Bruin and Bennett, 2020; Haischer et al., 2020; Hao et al., 2021; Malik et al., 2020; Kerr et al., 2021; Barrios and Hochberg, 2020). Similarly, individuals who identified as being more liberal had more trust in scientists and the government to manage risks of COVID-19 (O'Shea and Ueda, 2021; Beall et al., 2021; Cacciatore et al., 2018; Gauchat, 2012; Funk et al., 2019). Although some scholars suggest COVID-19 was unusually politicized and impacted by cultural cognition (Liu and Yang, 2023), this study suggests cultural cognition may also shape how hunters understand and prefer to manage CWD. The COVID-19 pandemic appeared to exacerbate the polarization of conservation issues within the 2020 election cycle in the U.S. (Casola et

al., 2020). Cultural cognition among politically conservative hunters in our study could explain why they viewed CWD as less risky than their more liberal counterparts, and why they were less willing to support management regulations established by experts. Specifically, conservative cultural cognition promotes opposition to and skepticism towards government- and expert-mandated regulations (Whitehead and Perry, 2020), and it provides an intuitive explanation for conservative hunters showing less support for agency interventions designed to limit the spread of CWD. Similarly, liberal cultural cognition tends to accentuate concern about environmental hazards (Casola, et al., 2020), and may explain why politically moderate and liberal hunters reported being less willing to expose themselves to CWD through hunting in areas with known infections (Smith et al., 2023) but more supportive of management than conservative hunters.

Both risk theory and strategic bias may explain why South Carolina hunters were more concerned about CWD and more willing to support management than North Carolina hunters. In many previous studies state effects were weak (Lyon and Vaske, 2010) or unusable due to small sample sizes (Needham et al., 2004). Lyon and Vaske (2010), however, reported hunters from states that had not yet detected CWD at the time of data collection (ie., Arizona, North Dakota) were more likely to report changing their behavior compared to hunters in states already impacted by CWD (ie., Wisconsin). They suggest hunters' dedication and real world experience with CWD encouraged study participants to discount hypothetical risks and information in their survey. These differences seem less extreme when comparing North Carolina and South Carolina, although CWD may have been higher on the uncertain dimension of risk for South Carolina hunters given the disease was not detected there at the time of this study. People attribute higher risks to hazards that are new or unknown and demonstrate more support for mitigating those risks (Fischhoff et al., 1978; Sjoberg, 2000; Slovic, 1978), which may explain why such management support was higher in South Carolina than North Carolina. An alternative explanation for our results is strategic bias, which is the tendency to deliberately and systematically distort or misstate information for strategic purposes (Flyvbjerg, 2021). In this case, North Carolina hunters may purposefully report less willingness to support management strategies like banning baiting and restricting movement of deer skulls and spinal cords from the location where the deer was harvested because they want to avoid regulations that might realistically be considered

by the agency following CWD detection. Conversely, supporting the same CWD management strategies may feel purely hypothetical, and less likely to actually impact hunting opportunities, for South Carolina hunters since the disease was not yet detected in their state.

Our study also contributes to previous research by suggesting knowledge level, risk perceptions, age, and education retain independent effects on CWD management preferences after accounting for political identity. Although previous human dimensions studies on CWD have tested for hunters' knowledge of the disease (Vaske et al., 2006), our study is the first to suggest more knowledge predicts a lower acceptance for the state agency to do nothing to manage CWD. Hunters who are more knowledgeable about CWD might be more willing to support management because they know of the detrimental effects that this disease has on deer population numbers. Similarly, hunters who reported higher education levels may have been more likely to support specific CWD management interventions if their education enhanced their awareness of disease management concepts and principles (e.g., reducing density, reducing mobility of vectors). Regardless of the mechanisms involved, these relationships reflect prior human dimensions work demonstrating the value of education as a channel to increase hunters' cooperation in accomplishing deer management objectives, such as reaching a harvest quota (Decker and Connelly, 1990). High risk perceptions may increase hunter beliefs that CWD needs to be eradicated (Cooney and Holsman, 2010), leading to higher levels of support for agency intervention to control its spread. Similarly, one explanation for the relationship between higher concern and reduced hunting frequency is the possible health risks that are associated with CWD (Vaske et al., 2004). Higher risk perception and aversion also provides an explanation for why older hunters reported being less willing to hunt in areas where CWD was detected or to consume meat from deer harvested in those areas (Lyon and Vaske, 2010; Miller et al., 2004). Other studies have also shown that older hunters are more likely to comply with disease management practices for deer (e.g., tuberculosis) than younger hunters, including feeding and baiting restrictions (O'Brien et al., 2006).

Future research could engage participants with a more balanced political identity (i.e., landowners) to determine if there are identity related thresholds that our conservative-leaning sample of hunters could

not detect. Other studies could implement a more rigorous examination of political identity in their data collection instruments. Rather than just asking one question indicating how respondents identify on a 5-point scale, other researchers may want to ask multiple questions about voter preferences and responses to politically-charged issues (Kahan, 2015). Researchers could also apply the cultural cognition scales, which include "hierarchy-egalitarianism" and "individualism-communitarianism" continuous attitudinal scales, to enhance their assessment of stakeholders' cultural cognitions (Kahan, 2008). This additional data would allow for a more complete, rigorous, and holistic analysis of political identity on wildlife disease management. Similarly, future research focused on other metrics for identity (e.g., environmental worldview) might be insightful. Liberal and conservative identities do not parallel political groups in other international contexts as closely as they do in the United States, where they have become seemingly inseparable (Pew Research Center, 2017), highlighting the need for research in other cultural contexts. Another possible limitation of this study that might be addressed in future research is self-report accuracy (Beall et al., 2021). Some hunters might have responded to questions in a way that they believe will be viewed favorably by the state wildlife agencies. However, the anti-management views among hunters reporting politically conservative identities may reduce social desirability bias in this case. Lastly, to examine whether hunters actually alter their hunting frequency or comply with management regulations, another study could be administered that tests behavioral differences between conservatives and moderates/liberals in a state where CWD already exists.

Management Implications

In the field of natural resource management today, the OneHealth initiative has molded the way in which stakeholders think about wildlife health. Just as zoonotic diseases are nearly impossible to manage without the support of key stakeholders, CWD should not be managed without the input of hunters. This study outlines ways we can potentially integrate social science more effectively into the decision-making process and management of CWD.

This study has several implications for garnering support from hunters for CWD management. First, CWD management in predominantly politically conservative regions (e.g., 'red counties', rural areas) may benefit from a focus on advocacy campaigns building support for scientifically grounded management and intervention strategies with the goal of minimizing the spread of CWD and protecting the deer herd. Second, CWD management in predominantly politically liberal regions (e.g., blue counties, peri-urban regions) may benefit from advocacy campaigns highlighting the relatively low risk of engaging in deer hunting within CWD management zones. Thirdly, since controlling overabundant deer herds is essential to managing CWD, it's important to note that conservative hunters are primed and ready to fulfill this management niche, whereas liberal hunters might need more persuasion to do the same. Fourth, advocacy campaigns may benefit from an emphasis on impacts to deer population and hunting, two impacts of high concern across the whole range of political identities. Fifth, managers may need to engage directly with older hunters (just as they might do with moderate/liberal hunters) to alleviate concerns about the risks posed by hunting in areas where CWD has been detected. Ultimately, this study suggests that, when operating in a world where political polarization over conservation issues such as wildlife disease management is prominent, communication products must be developed with audience ideology in mind.

Data Availability

The datasets used for the analyses of this study are not accessible because the Institutional Review Board prohibits the distribution of data related to human subjects. Requests to access the data should be directed to Catherine Sam Lerose, cslerose@ncsu.edu.

Conflict of Interest

There are no conflicts of interests among the authors of this paper.

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REFERENCES

Abdi, H. (2010). Holm's sequential Bonferroni procedure. *Encyclopedia of research design*, *1*(8), 1-8.

Allcott, H., Boxell, L., Conway, J., Gentzkow, M., Thaler, M., & Yang, D. (2020). Polarization and public health: Partisan differences in social distancing during the coronavirus pandemic. *Journal of public economics*, *191*, 104254.

Arbuckle, J. L. (2019). Amos (Version 26.0) [Windows]. Chicago: IBM SPSS.

Barrios, J., & Hochberg, Y. (2020). Risk perception through the lens of politics in the time of the COVID-19 pandemic. https://doi.org/10.3386/w27008

Beall JM, Casola WR, Peterson MN, Larson LR, Carr WA, Seekamp E, Stevenson KT and Jackson SB (2021) Cultural Cognition and Ideological Framing Influence Communication About Zoonotic Disease in the Era of COVID-19. *Front. Commun.* 6:645692. doi: 10.3389/fcomm.2021.645692

Beall, J. M., Jackson, S. B., Casola, W. R., Peterson, M. N., Larson, L. R., Stevenson, K. T., & Seekamp, E. (2022). Self-reported participation in outdoor and nature-based recreation before and during the COVID-19 pandemic supports psychological health and well-being. *Wellbeing, Space and Society*, *3*, 100094.

Belay, E. D., Maddox, R. A., Williams, E. S., Miller, M. W., Gambetti, P., & Schonberger, L. B. (2004). Chronic wasting disease and potential transmission to humans. *Emerging infectious diseases*, *10*(6), 977.

Bloom, J. D., Chan, Y. A., Baric, R. S., Bjorkman, P. J., Cobey, S., Deverman, B. E., Fisman, D. N., Gupta, R., Iwasaki, A., Lipsitch, M., Medzhitov, R., Neher, R. A., Nielsen, R., Patterson, N., Stearns, T., Nimwegen, E. V., Worobey, M., & Relman, D. A. (2021, May 14). Investigate the origins of COVID-19. Science. Retrieved December 6, 2022, from https://www.science.org/doi/full/10.1126/science.abj0016?casa_token=odSt-hguvdYAAAAA%3AbMnH_fP6BHuTWNsjqmM11onXcvzJsInC6HA6R1Sr2fXflfaJdgL-Jx5OE_9Allx9nQPnUv4Jj5zd.

Boglioli, M. (2009). *A matter of life and death: Hunting in contemporary Vermont*. Univ of Massachusetts Press.

Bolsen, T., Palm, R., & Kingsland, J. T. (2020). Framing the origins of COVID-19. *Science communication*, *42*(5), 562-585.

Bonilla-Aldana, D. K., Dhama, K., & Rodriguez-Morales, A. J. (2020). Revisiting the one health approach in the context of COVID-19: A look into the ecology of this emerging disease. *Advances in Animal and Veterinary Sciences*, *8*(3). https://doi.org/10.17582/journal.aavs/2020/8.3.234.237

Brown, T. L., Decker, D. J., Major, J. T., Curtis, P. D., Shanahan, J. E., & Siemer, W. F. (2006). Hunters' and other citizens' reactions to discovery of CWD in central New York. Human Dimensions of Wildlife, 11(3), 203–214. https://doi.org/10.1080/10871200600669924

Bruine de Bruin, W., & Bennett, D. (2020). Relationships between initial COVID-19 risk perceptions and protective health behaviors: A national survey. American Journal of Preventive Medicine, 59(2), 157– 167.

Bruine de Bruin, W., Saw, HW. & Goldman, D.P. Political polarization in US residents' COVID-19 risk perceptions, policy preferences, and protective behaviors. *J Risk Uncertain* 61, 177–194 (2020). https://doi.org/10.1007/s11166-020-09336-3

Burke, C. R., Peterson, M. N., Sawyer, D. T., Moorman, C. E., Serenari, C., Meentemeyer, R. K., & DePerno, C. S. (2019). Predicting private landowner hunting access decisions and hunter density. *Human Dimensions of Wildlife*, *24*(2), 99-115.

Cacciatore, M. A., Meng, J., Reber, B. H., & Boyd, B. (2018). Globalization effects or a growing cultural divide? a three-year comparative analysis of trust predictors in the US and China. *Chinese Journal of Communication*, *11*(1), 45-65.

Calvillo, D. P., Ross, B. J., Garcia, R. J., Smelter, T. J., & Rutchick, A. M. (2020). Political ideology predicts perceptions of the threat of COVID-19 (and susceptibility to fake news about it). *Social Psychological and Personality Science*, *11*(8), 1119-1128.

Casola, W. R., Beall, J. M., Nils Peterson, M., Larson, L. R., Brent Jackson, S., & Stevenson, K. T. (2022). Political polarization of conservation issues in the era of covid-19: An examination of partisan perspectives and priorities in the United States. *Journal for Nature Conservation*, *67*, 126176. https://doi.org/10.1016/j.jnc.2022.126176

Casola, W. R., Rushing, J., Futch, S., Vayer, V., Lawson, D. F., Cavalieri, M. J., ... & Peterson, M. N. (2020). How do YouTube videos impact tolerance of wolves?. *Human Dimensions of Wildlife*, *25*(6), 531-543.

Centers for Disease Control and Prevention. (2022, July 1). *Occurrence*. Centers for Disease Control and Prevention. Retrieved February 9, 2023, from https://www.cdc.gov/prions/cwd/occurrence.html

Chakraborty, I., & Maity, P. (2020). COVID-19 outbreak: Migration, effects on society, global environment and prevention. *Science of the total environment*, *728*, 138882.

Charnley, S., Carothers, C., Satterfield, T., Levine, A., Poe, M. R., Norman, K., Donatuto, J., Breslow, S. J., Mascia, M. B., Levin, P. S., Basurto, X., Hicks, C. C., García-Quijano, C., & St. Martin, K. (2017). Evaluating the best available social science for natural resource management decision-making. *Environmental Science & Policy*, *73*, 80–88. https://doi.org/10.1016/j.envsci.2017.04.002

Chen, X., Peterson, M. N., Hull, V., Lu, C., Hong, D., & Liu, J. (2013). How perceived exposure to environmental harm influences environmental behavior in urban China. *Ambio*, *42*, 52-60.

Cooper, C., Larson, L., Dayer, A., Stedman, R., & Decker, D. (2015). Are wildlife recreationists conservationists? Linking hunting, birdwatching, and pro-environmental behavior. *The Journal of Wildlife Management*, *79*(3), 446-457.

Cowan, S. K., Mark, N., & Reich, J. A. (2021). COVID-19 vaccine hesitancy is the new terrain for political division among Americans. *Socius*, *7*, 23780231211023657.

Craney, T. A., & Surles, J. G. (2002). Model-dependent variance inflation factor cutoff values. *Quality engineering*, *14*(3), 391-403.

Dalrymple, C. J., Peterson, M. N., Bondell, H. D., Rodriguez, S. L., Fortney, J., Cobb, D. T., & Sills, E. O. (2010). Understanding angler and hunter annual spending in North Carolina. In *Proceedings of the annual conference of the Southeastern Association of Fish and Wildlife Agencies* (Vol. 64, pp. 88-94).

Decker, D. J., & Connelly, N. A. (1990). The need for hunter education in deer management: insights from New York. *Wildlife Society Bulletin (1973-2006)*, *18*(4), 447-452.

Deruiter, D. S. (2002). A qualitative approach to measuring determinants of wildlife value orientations. *Human Dimensions of Wildlife*, *7*(4), 251-271.

Desimone, L. M., & Le Floch, K. C. (2004). Are we asking the right questions? Using cognitive interviews to improve surveys in education research. *Educational evaluation and policy analysis*, *26*(1), 1-22.

Dillman, D. A., Smyth, J. D., & Christian, L. M. (2014). *Internet, phone, mail, and mixed-mode surveys: The tailored design method*. John Wiley & Sons.

Druckman, J., Klar, S., Krupnikov, Y., Levendusky, M., & Ryan, J. (2021). How Affective Polarization Shapes Americans' Political Beliefs: A Study of Response to the COVID-19 Pandemic. *Journal of Experimental Political Science*, *8*(3), 223-234. doi:10.1017/XPS.2020.28

Dunlap, R. E., & McCright, A. M. (2008). A widening gap: Republican and Democratic views on climate change. *Environment: Science and Policy for Sustainable Development*, **50**(5), 26–35.

Edelman, M. (2020). From 'populist moment'to authoritarian era: challenges, dangers, possibilities. *Critical Agrarian Studies*, 465.

Etter, J. F., & Perneger, T. V. (1997). Analysis of non-response bias in a mailed health survey. *Journal of clinical epidemiology*, *50*(10), 1123-1128.

EUROPE, P., & Mudde, C. (2007). Populist radical right parties in Europe.

Flyvbjerg, B. (2021). Top ten behavioral biases in project management: An overview. *Project Management Journal*, *52*(6), 531-546.

Fridman, A., Gershon, R., & Gneezy, A. (2021). COVID-19 and vaccine hesitancy: A longitudinal study. *PloS one*, *16*(4), e0250123.

Fulton, D. C., Manfredo, M. J., & Lipscomb, J. (1996). Wildlife value orientations: A conceptual and measurement approach. *Human dimensions of wildlife*, *1*(2), 24-47.

GIGLIOTTI, L. A. R. R. Y. M. (2004). Hunters' concerns about Chronic wasting disease in South Dakota. Human Dimensions of Wildlife, 9(3), 233–235. https://doi.org/10.1080/10871200490480006

Green, J., Edgerton, J., Naftel, D., Shoub, K., & Cranmer, S. J. (2020). Elusive consensus: Polarization in elite communication on the COVID-19 pandemic. *Science Advances*, *6*(28). https://doi.org/10.1126/sciadv.abc2717

Haggerty, J. H. (2007). "I'm not a greenie but…": Environmentality, eco-populism and governance in New Zealand Experiences from the Southland whitebait fishery. *Journal of rural studies*, *23*(2), 222-237.

Haischer, M. H., Beilfuss, R., Hart, M. R., Opielinski, L., Wrucke, D., Zirgaitis, G., Uhrich, T. D., & Hunter, S. K. (2020). Who is wearing a mask? gender-, age-, and location-related differences during the COVID-19 pandemic. *PLOS ONE*, *15*(10). https://doi.org/10.1371/journal.pone.0240785

Hallas, L., Hatibie, A., Majumdar, S., Pyarali, M., Hale, T. (2020). "Variation in US states' responses to COVID-19 2.0." Blavatnik School of Government Working Paper. Available: www.bsg.ox.ac.uk/covidtracker

Hanisch-Kirkbride, S. L., Riley, S. J., & Gore, M. L. (2013). Wildlife disease and risk perception. *Journal of wildlife diseases*, *49*(4), 841-849.

Hao, F., Shao, W., Huang, W. (2021). Understanding the influence of contextual factors and individual social capital on American public mask wearing in response to COVID–19, Health & Place, Volume 68, 102537,ISSN 1353-8292, https://doi.org/10.1016/j.healthplace.2021.102537.

Harper, E. E., Miller, C. A., & Vaske, J. J. (2015). Hunter perceptions of risk, social trust, and management of chronic wasting disease in Illinois. *Human Dimensions of Wildlife*, *20*(5), 394-407.

Hartman TK, Marshall M, Stocks TVA, McKay R, Bennett K, Butter S, Gibson Miller J, Hyland P, Levita L, Martinez AP, Mason L, McBride O, Murphy J, Shevlin M, Vallières F and Bentall RP (2021) Different Conspiracy Theories Have Different Psychological and Social Determinants: Comparison of Three Theories About the Origins of the COVID-19 Virus in a Representative Sample of the UK Population. *Front. Polit. Sci.* 3:642510. doi: 10.3389/fpos.2021.642510

Haus, J. M., Eyler, T. B., Duda, M. D., & Bowman, J. L. (2017). Hunter perceptions toward chronic wasting disease: Implications for harvest and management. *Wildlife Society Bulletin*, *41*(2), 294-300.

Hermann, N., Voß, C., & Menzel, S. (2013). Wildlife value orientations as predicting factors in support of reintroducing bison and of wolves migrating to Germany. *Journal for Nature Conservation*, *21*(3), 125-132.

IBM Corp. Released 2021. IBM SPSS Statistics for Windows, Version 28.0. Armonk, NY: IBM Corp

Inglehart, R. F., & Norris, P. (2016). Trump, Brexit, and the rise of populism: Economic have-nots and cultural backlash.

Jacobs, M. H., Vaske, J. J., & Sijtsma, M. T. (2014). Predictive potential of wildlife value orientations for acceptability of management interventions. *Journal for Nature Conservation*, *22*(4), 377-383.

Jennelle CS, Henaux V, Wasserberg G, Thiagarajan B, Rolley RE, Samuel MD (2014) Transmission of Chronic Wasting Disease in Wisconsin White-Tailed Deer: Implications for Disease Spread and Management. PLoS ONE 9(3): e91043. https://doi.org/10.1371/journal.pone.0091043

Jiang, J., Chen, E., Yan, S., Lerman, K., and Ferrara, E. (2020). Political Polarization Drives Online Conversations aboutCOVID-19 in the United States. Hum. Behav Emerg Tech 2 (3), 200–211. doi:10.1002/hbe2.202

Ju, Y., & You, M. (2022). It's politics, isn't it? investigating direct and indirect influences of political orientation on risk perception of COVID-19. *Risk Analysis*, *42*(1), 56-68.

Kahan, D. M. (2008). Cultural cognition as a conception of the cultural theory of risk. *HANDBOOK OF RISK THEORY, S. Roeser, ed., Forthcoming, Harvard Law School Program on Risk Regulation Research Paper*, (08-20).

Kahan, D. M., Braman, D., Monahan, J., Callahan, L., and Peters, E. (2010). Cultural Cognition and Public Policy: The Case of Outpatient Commitment Laws. *L. Hum. Behav.* 34 (2), 118–140. doi:10.1007/s10979-008-9174-4

Kahan, D. M., Jenkins-Smith, H., & Braman, D. (2011). Cultural cognition of scientific consensus. *Journal of risk research*, *14*(2), 147-174.

Kansky, R., Kidd, M., & Knight, A. T. (2016). A wildlife tolerance model and case study for understanding human wildlife conflicts. *Biological Conservation*, *201*, 137-145.

Kaplan, J. T., Gimbel, S. I., & Harris, S. (2016). Neural correlates of maintaining one's political beliefs in the face of counterevidence. *Scientific reports*, *6*(1), 39589.

Kerr, J., Panagopoulos, C., & van der Linden, S. (2021). Political polarization on covid-19 pandemic response in the United States. *Personality and Individual Differences*, *179*, 110892. https://doi.org/10.1016/j.paid.2021.110892

Kellert, S. R., & Berry, J. K. (1987). Attitudes, knowledge, and behaviors toward wildlife as affected by gender. *Wildlife Society Bulletin (1973-2006)*, *15*(3), 363-371.

Kettl, D. F. (2020). States divided: The implications of American federalism for Covid-19. *Public Administration Review*, *80*(4), 595–602. https://doi.org/10.1111/puar.13243

Lamot, M., Krajnc, M. T., & Kirbiš, A. (2020). Demographic and Socioeconomic Characteristics, Health Status and Political Orientation as Predictors of COVID-19 Vaccine Hesitancy among the Slovenian Public *Druzboslovne Razprave*, *36*.

Larson, L. R., Stedman, R. C., Decker, D. J., Siemer, W. F., & Baumer, M. S. (2014). Exploring the social habitat for hunting: Toward a comprehensive framework for understanding hunter recruitment and retention. Human Dimensions of Wildlife, 19(2), 105-122.

Larson, L. R., Whiting, J. W., & Green, G. T. (2011). Exploring the influence of outdoor recreation participation on pro-environmental behaviour in a demographically diverse population. *Local Environment*, *16*(1), 67-86.

Lawson, D. F., Stevenson, K. T., Peterson, M. N., Carrier, S. J., L. Strnad, R., & Seekamp, E. (2019). Children can foster climate change concern among their parents. *Nature Climate Change*, *9*(6), 458-462.

Le Page, M. (2021). Should we be worried by wild animals with covid-19?.

Lischka, S. A., Shelton, P., & Buhnerkempe, J. (2010). Support for chronic wasting disease management among residents of the infected area in Illinois. Human Dimensions of Wildlife, 15(3), 229–232. https://doi.org/10.1080/10871201003736054

Long, J. S., & Freese, J. (2006). *Regression models for categorical dependent variables using Stata* (Vol. 7). Stata press.

Lujala, P., Lein, H., & Rød, J. K. (2015). Climate change, natural hazards, and risk perception: the role of proximity and personal experience. *Local Environment*, *20*(4), 489-509.

Lyon, K. M., & Vaske, J. J. (2010). Predicting hunting participation in response to chronic wasting disease in four states. *Human Dimensions of Wildlife*, *15*(3), 208-220.

Malik, A. A., McFadden, S. M., Elharake, J., Omer, S.B. (2020). Determinants of COVID-19 vaccine acceptance in the US, EClinicalMedicine, Volume 26, 100495, ISSN 2589-5370, https://doi.org/10.1016/j.eclinm.2020.100495.

Manfredo, M. J., Teel, T. L., Don Carlos, A. W., Sullivan, L., Bright, A. D., Dietsch, A. M., ... & Fulton, D. (2020). The changing sociocultural context of wildlife conservation. *Conservation Biology*, *34*(6), 1549-1559.

Manfredo, M. J., Teel, T. L., & Henry, K. L. (2009). Linking society and environment: A multilevel model of shifting wildlife value orientations in the western United States. *Social Science Quarterly*, *90*(2), 407-427.

Manfredo, M. J., Teel, T. L., Sullivan, L., & Dietsch, A. M. (2017). Values, trust, and cultural backlash in conservation governance: The case of wildlife management in the United States. *Biological Conservation*, *214*, 303-311

Mauk, M. (2020). Rebuilding Trust in Broken Systems? Populist Party Success and Citizens' Trust in Democratic Institutions. *Politics and Governance*, *8*(3), 45-58.

McCorquodale, S. M. (1997). Cultural contexts of recreational hunting and native subsistence and ceremonial hunting: their significance for wildlife management. *Wildlife Society Bulletin (1973-2006)*, *25*(2), 568-573.

McGirr, L. (2015). Suburban warriors. In *Suburban Warriors*. Princeton University Press.

Meeks, A., Poudyal, N. C., Muller, L. I., & Yoest, C. (2022). Hunter acceptability of chronic wasting disease (CWD) management actions in western Tennessee. *Human Dimensions of Wildlife*, *27*(5), 457-471.

Miller, C. A., & Vaske, J. J. (2023). How state agencies are managing chronic wasting disease. *Human Dimensions of Wildlife*, *28*(1), 93-102.

Mukhtar, S. (2021). Psychology and politics of COVID-19 misinfodemics: Why and how do people believe in misinfodemics?. *International Sociology*, *36*(1), 111-123.

Muringai, V., & Goddard, E. (2018). Trust and consumer risk perceptions regarding BSE and chronic wasting disease. *Agribusiness*, *34*(2), 240-265.

Mysterud, A., Rivrud, I. M., Gundersen, V., Rolandsen, C. M., & Viljugrein, H. (2020). The unique spatial ecology of human hunters. *Nature Human Behaviour*, *4*(7), 694-701.

Needham, M. D., Vaske, J. J., Donnelly, M. P., & Manfredo, M. J. (2007). Hunting specialization and its relationship to participation in response to chronic wasting disease. *Journal of Leisure Research*, *39*(3), 413-437.

Needham, M. D., Vaske, J. J., & Manfredo, M. J. (2006). State and residency differences in hunters' responses to chronic wasting disease. *Human Dimensions of Wildlife*, *11*(3), 159-176.

Needham, M. D., Vaske, J. J., & Petit, J. D. (2017). Risk sensitivity and hunter perceptions of chronic wasting disease risk and other hunting, wildlife, and health risks. *Human Dimensions of Wildlife*, *22*(3), 197-216.

Needham, M. D., Vaske, J J., & Manfredo, M. J. (2004). Hunters' behavior and acceptance of management actions related to chronic wasting disease in eight states. Human Dimensions of Wildlife, 9(3), 211–231. https://doi.org/10.1080/10871200490479990

Palmer, M. V., Martins, M., Falkenberg, S., Buckley, A., Caserta, L. C., Mitchell, P. K., ... & Diel, D. G. (2021). Susceptibility of white-tailed deer (Odocoileus virginianus) to SARS-CoV-2. *Journal of virology*, *95*(11), e00083-21.

Parlee, B., Ahkimnachie, K., Cunningham, H., Jordan, M., & Goddard, E. (2021). "It's important to know about this"-risk communication and the impacts of chronic wasting disease on indigenous food systems in Western Canada. *Environmental Science & Policy*, *123*, 190-201.

Petchenik, J. (2006). Landowner responses to harvest incentives in Wisconsin's southwest chronic wasting disease eradication zone. Human Dimensions of Wildlife, 11(3), 225–226. https://doi.org/10.1080/10871200600669957

Poudyal, N. C. (2022). Residents' concerns and attitudes regarding wildlife disease management: A case of chronic wasting disease in Tennessee. *Human Dimensions of Wildlife*, 1-11.

Putsche, L., Hormel, L., Mihelich, J., & Storrs, D. (2017). "You end up feeling like the rest of the world is kind of picking on you": Perceptions of regulatory science's threats to economic livelihoods and Idahoans' collective identity. *Science Communication*, *39*(6), 687-712.

Quartuch, M.R. (2020). Measuring hunters' perceptions about chronic wasting disease (CWD), concerns associated with increasing CWD prevalence, and support for CWD management alternatives. Colorado Parks and Wildlife, technical report series #56.

Peterson, M. N., Chesonis, T., Stevenson, K. T., & Bondell, H. D. (2017). Evaluating relationships between hunting and biodiversity knowledge among children. *Wildlife Society Bulletin*, *41*(3), 530-536.

Potapov, A., Merrill, E., Pybus, M., & Lewis, M. A. (2016). Chronic wasting disease: Transmission mechanisms and the possibility of harvest management. *PLoS One*, *11*(3), e0151039.

Reisenwitz, T. H. (2016). Student evaluation of teaching: an investigation of nonresponse bias in an online context. *Journal of marketing education*, *38*(1), 7-17.

Riley, S. J., Decker, D. J., Enck, J. W., Curtis, P. D., Lauber, T. B., & Brown, T. L. (2003). Deer populations up, hunter populations down: implications of interdependence of deer and hunter population dynamics on management. *Ecoscience*, *10*(4), 455-461.

Rivera, N. A., Brandt, A. L., Novakofski, J. E., & Mateus-Pinilla, N. E. (2019). Chronic wasting disease in cervids: Prevalence, impact and management strategies. Veterinary Medicine: Research and Reports, Volume 10, 123–139. https://doi.org/10.2147/vmrr.s197404

Robinson, S. J., Samuel, M. D., O'Rourke, K. I., & Johnson, C. J. (2012). The role of genetics in chronic wasting disease of North American cervids. *Prion*, *6*(2), 153-162.

Rubino, E. C., & Serenari, C. (2022). Using Latent Profile Analysis to Evaluate Preferences for Chronic Wasting Disease Management Options among Different Hunter Types. *Animals*, *12*(20), 2751.

Ryan, E. L., & Shaw, B. (2011). Improving hunter recruitment and retention. *Human Dimensions of Wildlife*, *16*(5), 311-317.

Saunders, S. E., Bartelt-Hunt, S. L., & Bartz, J. C. (2012). Occurrence, transmission, and zoonotic potential of chronic wasting disease. *Emerging infectious diseases*, *18*(3), 369.

Schroeder, S. A., Landon, A. C., Cornicelli, L., Fulton, D. C., & McInenly, L. (2021). Institutional trust, beliefs, and evaluation of regulations, and management of chronic wasting disease (CWD). *Human Dimensions of Wildlife*, *26*(3), 228-244.

Serenari, C., Shaw, J., Myers, R., & Cobb, D. T. (2019). Explaining deer hunter preferences for regulatory changes using choice experiments. *The Journal of Wildlife Management*, *83*(2), 446-456.

Shao, W., & Hao, F. (2020). Confidence in political leaders can slant risk perceptions of COVID–19 in a highly polarized environment. *Social Science & Medicine*, *261*, 113235. https://doi.org/10.1016/j.socscimed.2020.113235

Shevlin, M., & Miles, J. N. (1998). Effects of sample size, model specification and factor loadings on the GFI in confirmatory factor analysis. *Personality and Individual differences*, *25*(1), 85-90.

Siegrist, M., & Cvetkovich, G. (2000). Perception of hazards: The role of social trust and knowledge. *Risk analysis*, *20*(5), 713-720.

Singer, P. M., Willison, C. E., & Greer, S. L. (2020). Infectious disease, public health, and politics: United States response to Ebola and Zika. *Journal of public health policy*, *41*, 399-409.

Sjöberg, L. (2003). Distal factors in risk perception. *Journal of risk research*, *6*(3), 187-211.

Slagle, K. M., Karns, G., Bruskotter, J. T., & Wilson, R. S. (2022). Research note: human behavior and effective chronic wasting disease management. *Human Dimensions of Wildlife*, 1-9.

Slovic, P. E. (2000). *The perception of risk*. Earthscan publications.

Smith, H., Allf, B., Larson, L., Futch, S., Lundgren, L., Pacifici, L., & Cooper, C. (2021). Leveraging citizen science in a college classroom to build interest and efficacy for science and the environment. *Citizen Science: Theory and Practice*, *6*(1).

Smith, K., Landon, A. C., Schroeder, S. A., & McInenly, L. E. (2023). Application of the Heuristic-Systematic Model to Chronic wasting Disease Risk perceptions. *Society & Natural Resources*, 1-19.

Sponarski, C. C., Vaske, J. J., & Bath, A. J. (2015). The role of cognitions and emotions in human–coyote interactions. *Human Dimensions of Wildlife*, *20*(3), 238-254.

Streiner DL (2005) Finding our way: An introduction to path analysis. Can J Psychiatry 50:115–122

Swigart, K. L., Anantharaman, A., Williamson, J. A., & Grandey, A. A. (2020). Working while liberal/conservative: A review of political identity in organizations. *Journal of Management*, *46*(6), 1063-1091.

Valdez, R. X., Peterson, M. N., & Stevenson, K. T. (2018). How communication with teachers, family and friends contributes to predicting climate change behaviour among adolescents. *Environmental Conservation*, *45*(2), 183-191.

Van Lange, P. A., Bekkers, R., Chirumbolo, A., & Leone, L. (2012). Are conservatives less likely to be prosocial than liberals? From games to identity, political preferences and voting. *European Journal of Personality*, *26*(5), 461-473.

Vaske, J. J. (2010). Lessons learned from human dimensions of chronic wasting disease research. *Human Dimensions of Wildlife*, *15*(3), 165-179.

Vaske, J. J., & Miller, C. A. (2018). Hunters and non-hunters chronic wasting disease risk perceptions over time. *Society & Natural Resources*, *31*(12), 1379-1388.

Vaske, J. J., Miller, C. A., Parent, C., & Bahnson, C. (2022). Information sources and knowledge about chronic wasting disease in North Dakota. *Human Dimensions of Wildlife*, 1-10.

Vaske, J. J., Needham, M. D., Stafford, N. T., Green, K., & Petchenik, J. (2006). Information sources and knowledge about chronic wasting disease in Colorado and Wisconsin. *Human Dimensions of Wildlife*, *11*(3), 191-202.

Vaske, J. J., Timmons, N. R., Beaman, J., & Petchenik, J. (2004). Chronic wasting disease in Wisconsin: Hunter behavior, perceived risk, and agency trust. *Human Dimensions of Wildlife*, *9*(3), 193-209.

Walton, B. K., & Bailey, C. (2005). Framing wilderness: Populism and cultural heritage as organizing principles. *Society and Natural Resources*, *18*(2), 119-134.

Whittaker, D., Vaske, J. J., & Manfredo, M. J. (2006). Specificity and the cognitive hierarchy: Value orientations and the acceptability of urban wildlife management actions. *Society and Natural Resources*, *19*(6), 515-530.

APPENDIX

Supplemental File A. Results from a Factor Analysis of Risk Perception, Concern for People, Concern for Deer Populations and Hunting, Acceptance of Decreasing Deer Populations, and Acceptance of CWD Management Interventions among Deer Hunters in North and South Carolina.

Item	Factor Loading	
	1	Communality
Factor 1: Risk Perception		
RISK 1: Accidentally eating meat from an animal infected with CWD	0.903	0.815
RISK 2: Becoming ill as a result of exposure to CWD	0.903	0.815
Factor 2: Concern for People		
CONCERN 1: Your own personal health	0.977	0.954
CONCERN 2: The health of other people you know	0.977	0.954
Factor 3: Concern for Deer Populations and Hunting		
CONCERN 1: The potential for CWD to dramatically reduce the deer population in North/South Carolina	0.966	0.932
CONCERN 2: The threat CWD poses to the future of deer hunting in North/South Carolina	0.966	0.932
Factor 4: Acceptance of Decreasing Deer Populations		
ITEM 1: Significantly decreasing the overall deer population	0.934	0.873
ITEM 2: Significantly decreasing the overall number of mature bucks	0.934	0.873
Factor 5: Acceptance of CWD Management Interventions		
MANAGEMENT 2: Require unused deer parts to be buried, incinerated, or disposed of in a landfill	0.671	0.451
MANAGEMENT 3: Require all hunters to provide a sample for testing	0.782	0.612
MANAGEMENT 4: Ban supplemental feeding and baiting of deer	0.682	0.466
MANAGEMENT 5: Ban removal of deer skulls and spinal cords from the location where the deer was harvested	0.694	0.482

CHAPTER 2: What are Hunters Willing to Pay for CWD Management? A Comparison of Different Contingent Valuation Approaches

Catherine Sam Lerose

In collaboration with M. Nils Peterson, Lincoln R. Larson, Jay F. Levine, William Casola, Moriah Boggess, Cristina Watkins, Joseph Fuller, Jonathan Shaw, Christopher Kreh, and Bradley Howard

Abstract

Non-market valuation represents a critical tool for managing emerging zoonotic diseases. The mode in which contingent valuation (CV) questions are asked can impact valuations due to strategic biases inherent to self-reporting economic decisions. Many studies use open-ended CV prompts to determine how much stakeholders will pay to mitigate risks posed by emerging diseases. While this method is often the most logistically feasible, economists argue it introduces more bias than dichotomous choice assessment models. In this case study, we compare two survey modes and two CV methods for assessing willingness to pay for management of chronic wasting disease (CWD) in white-tailed deer. Chronic wasting disease has posed a challenge for wildlife managers since the 1960s and continues to spread around the world. Agencies in CWD-prevalent regions have adopted costly testing and carcass disposal practices to mitigate the spread of this fatal and highly-transmissible disease. We administered online surveys (n=1,430) and conducted phone surveys (n=602) in North and South Carolina to assess how much deer hunters were willing to pay for CWD testing and disposal across different survey modes and CV methods. Among the online survey respondents, 34.1% (n=488) hunters were willing to pay for testing and 43.4% (n=620) were willing to pay for disposal. Of the hunters we sampled over the phone, 48.6% (n=293) were willing to pay a fee for testing and 50.7% (n=306) for disposal. Survey mode affected mean WTP for testing and disposal in open-ended questions, with lower estimates from the online survey (M = \$15.96, 95% CI [0 – 49.83] for testing; \$14.74, 95% CI [0 – 39.02] for disposal) than the phone survey (M = \$22.90, 95% CI [0 – 53.42] for testing; \$22.80, 95% CI [0 – 51.69] for disposal). Different CV methods, however, only yielded minor differences in WTP estimates reported on our phone survey (dichotomous choice responses: M = \$24.80, 95% CI [23.31 - 26.29] for testing; \$24.50, 95% CI [23.11 - 25.89] for disposal). Higher WTP estimates in

phone surveys, relative to online, may be explained by interviewer effects where respondents want to appear supportive and compliant. The fact that cost-efficient, open-ended WTP methods produced average WTP values nearly identical to those generated by the more complex and costly dichotomous choice methods is encouraging, but higher variance for open-ended methods remains an important limitation. Our research provides some justification for simple and relatively easy open-ended CV methods of assessing WTP for wildlife disease management among stakeholders, and underscores the need to account for survey mode when collecting and interpreting data about WTP.

Introduction

Recent outbreaks of zoonotic diseases have made disease management a major policy priority for state wildlife agencies. The World Health Organization recognizes zoonotic diseases as a global concern for human health, with potential for significant economic impacts (Thulin et al., 2015). With limited public funding available for management, policy makers and management officials need to be able to justify and encourage public investment in wildlife disease mitigation. Non-market valuation methods can serve as a critical tool in disease management and decision making by informing efforts to estimate costs of effectively managing wildlife diseases (Bennett and Balcombe, 2012; Tait et al., 2017), as well as efforts to assess potential economic support for management among key stakeholder groups (Ufer et al., 2022; Smith et al., 2019). Non-market valuation allows for the estimation of values people place on ecosystem goods and services for which there are no market prices (Manero et al., 2022). One of the challenges in managing wildlife disease is the lack of measurable transactions; however, application of nonmarket valuation methods can assist with placing an economic value on mitigating impacts of wildlife diseases.

Contingent valuation (CV) may be the most frequently used non-market valuation tool for estimating the costs and benefits of wildlife disease management (Elkstrand and Loomis, 1997). Contingent valuation is a stated preference (survey) method in which respondents are asked to state their preferences in hypothetical or contingent markets that allows analysts to estimate demands for goods or

services that are not traded in markets, and it is widely used in cost-benefit analysis and environmental impact assessment (Markandya and Ortiz, 2011; Carson and Hanemann, 2005; Venkatachalam, 2004). Contingent valuation approaches form the core of economic valuation studies investigating zoonotic disease management because they reveal important patterns in the public's willingness to pay (WTP) for solutions. Contingent valuation style questions are often administered via a survey in which participants are asked how much they are willing to pay for a particular good, service, or conservation project (Mitchell and Carson 1989). Willingness to pay can be interpreted as the monetary measure of how much the good or service is worth to individuals. Contingent valuation studies have been used to measure the public's WTP for a myriad of conservation goods including preventing species loss by introducing a hypothetical plan to protect habitat of endangered species (Loomis and Ekstrand, 1997), maintaining non-consumptive wildlife tourism by proposing a wildlife conservation trust fund (Barnes et al., 1999), and avoiding negative environmental impacts associated with lead ammunition (Pain et al., 2019; Ufer et al., 2022). Species characteristics that might influence public WTP for wildlife conservation include game status, conservation status, and an animal's charismatic nature (Dalrymple et al., 2012; Loomis and Elkstrand 1997; White et al., 2001).

The CV approaches used in many wildlife disease economics studies may, however, be vulnerable to at least two forms of bias. The mode of administration can introduce important limitations. Specifically, online surveys tend to overrepresent high income and younger demographics (Willems et al. 2006; Baker and Downes-Le Guin 2007; Ball 2019) and both groups tend to report higher WTP than their counterparts, yielding higher overall CV estimates (Shultz and Lindsay, 1990; Yu et al., 2014; Govindasamy and Italia, 1999). Social desirability bias may also contribute to lower WTP values in mail surveys relative to telephone surveys, where respondents attempt to show support for interviewers by reporting higher WTP values (Lindberg et al., 1997; Whitaker et al., 1998). Similarly, in-person interviews generated higher WTP estimates than those reported on self-administered questionnaires, providing more evidence for social desirability bias driven by CV administration mode (Leggett et al., 2003).

Frequent usage of open-ended rather than dichotomous choice questions in wildlife disease related CV research may also create biased valuation estimates. Despite theory-driven concerns about the validity of open-ended contingent valuation methods, they are still frequently used in research on zoonotic disease management (Bateman et al., 1994; Arbiol et al., 2013; Vajda et al., 2020; Esch et al., 2012). Open-ended WTP methods can fail to provide participants with cues as to plausible values, therefore making CV questions difficult to answer (Frew et al., 2003). Surveys using this format might yield low response rates, high item nonresponse, and possibly inaccurate valuations (Frew et al., 2003). Open-ended formats are vulnerable to strategic bias because the respondent has more autonomy to answer the WTP question in a way that is favorable to them (Doyon and Bergeron, 2016). Since it is more difficult for a respondent to come up with their own estimate of WTP than to say "yes" or "no" to a bid level that is presented to them, they might be more likely to say a low value when asked about WTP via an open-ended format (Mitchell and Carson, 2013; McCollum and Miller 1994; Brown et al., 1996). Scholars also suggest dichotomous choice methods yield more valid results because people are conditioned to choose whether or not to purchase a good at a set price, but find open-ended propositional unfamiliar and difficult to respond to (Kealy and Turner, 1993). The dichotomous choice approach has gained acceptance for its incentive compatibility (i.e., it induces respondents to reveal their true preferences) and therefore high probability of yielding accurate estimates of true WTP (Hoyos and Mariel, 2010; Cummings et al., 1995). Collectively these arguments have made dichotomous choice methods the preferred option among many CV scholars (Hammitt et al., 2001) and government agencies in the US and Europe that are charged with non-market valuation (Hoyos and Mariel, 2010). Despite multiple limitations, open-ended CV approaches do offer important benefits. First, an open-ended strategy can produce more precise estimates of respondents' willingness to pay (van der Pol et al., 2008). Second, open-ended methods avoid starting point biases (Lusk and Hudson, 2004). Third, open-ended methods avoid 'yeah-saying' (i.e., a respondent's tendency to say "yes" to any payment amount for provision of a public good or a respondent saying "yes" to a question without really meaning it) from the respondent (Alvarez-Farizo et al., 1999; Michell and Carson, 1989; Jamelske and Kipperberg, 2006; Sakashita et al.,

2012). The results from eleven contingent valuation surveys that compared WTP formats demonstrated that mean WTP values found from the dichotomous choice methods consistently exceeded the mean WTP values derived from the open-ended methods (Brown et al., 1996), potentially impacting interpretations regarding nonuse valuation.

We build on this research by comparing estimates of WTP for CWD management derived from two types of survey modes (online and phone) and valuation methodologies (open-ended and dichotomous choice questions) for North Carolina and South Carolina hunters. CWD has impacted the health of populations in the cervid family including white-tailed deer, elk, and moose (Uehlinger et al., 2016). The threat posed by CWD has also become an obstacle to maintaining hunting participation around the United States and abroad (Lyon and Vaske, 2010). CWD is a costly disease because wildlife agencies have to provide financial support to increase surveillance and security of highly-impacted areas (Rivera et al., 2019), compensate for sample testing (Carlson, 2018), and pay for the depopulation of captive cervid facilities (Bureau, 2006). Therefore, research on how to mitigate the spread of CWD has focused on the amount of monetary assistance key wildlife stakeholders are willing to pay to support management (Lu et al., 2015). Both dichotomous choice (Ufer et al., 2022) and open-ended (Adhikari et al., 2022) methods and multiple survey modes (e.g., phone, online) are being used for non-market valuation research in domains related to wildlife disease management (Bennett and Balcombe, 2012; Tait et al., 2017). We focused on hunters' WTP for CWD testing and carcass disposal, two services critical to control the disease and services that could be considered public goods in the eyes of hunters. Recent studies have assessed hunters' WTP for other CWD management practices, such as acquiring a voucher for free processing of a deer (Adhikari et al., 2022). However, to our knowledge, no other study has reported the amounts that hunters, or any other stakeholder group, would be willing to pay for CWD testing and safe disposal. We tested three research questions: (1) What is the predicted amount that the "average" hunter would be willing to pay for testing and disposal across both online and phone surveys derived from the open-ended and dichotomous choice questions?, (2) How different are the average WTP amounts for testing and disposal derived from the open-ended questions across both survey modes and derived from

the phone survey across both CV methods?, and (3) How do the demographic attributes of hunters predict their WTP for testing and disposal? The CWD management context represents an important one for understanding potential biases in non-market valuation given both the growing cost of managing this disease and the rapid expansion of economic research employing diverse modes and methods.

Methods

Sampling & Data Collection

Our study of hunters' WTP for CWD management focused on two southeastern states: North Carolina (a state where the disease was recently detected) and South Carolina (a state where the disease has not yet been detected). In North Carolina, we administered our survey to a simple random sample of 8,490 adult (age 18 years or older) North Carolina hunters who were licensed to hunt white-tailed deer between 2018 and 2020. Most (n=5,178) had email addresses and received invitations to take an online Qualtrics survey in March of 2022. Participants contacted via email, were sent one invitation and three reminders, each sent a week apart (Dillman et al., 2014). We deleted records for those who requested to be removed from the contact list (n = 9). The hunters who did not share email addresses were mailed postcards (n=3,312) with a link and a QR code to the online survey. We mailed three postcard reminders at two week intervals. After removing 126 incorrect addresses, we received 727 (for a response rate of 8.6%) responses, with 526 (72.4%) responses coming from email recruitment and 201 (27.6%) responses coming from postcard recruitment.

In South Carolina, we administered a survey to a simple random sample of 10,000 adult (age 18 years or older) South Carolina hunters who were licensed to hunt white-tailed deer in 2022. We sent them email invitations to take an online Qualtrics survey in October 2022. The email contained a link to the online survey. Similar to the North Carolina survey, we sent one invitation email and three reminder emails, each sent a week apart. We deleted records of those who asked to be removed from the contact list for this study (n = 7). We received a total of 703 responses from the email recruitment, for an online survey response

rate of 7.03%.

We also conducted phone interviews with hunters who had not responded to the requests to complete the online survey. The phone-based questionnaire used a subset of the questions from the online instrument that included willingness to pay (WTP) items. In North Carolina, the phone survey sample was randomly selected from the non-respondents to the online survey. In South Carolina, the phone survey sample was randomly selected from a list of hunters who did not respond to the online survey (n = 8,000) and hunters who did not have an email address on file (n = 230). We surveyed 302 participants via phone from North Carolina, with a compliance rate of 50.8%. We defined compliance rate as the proportion of people from the sample frame who answered questions after answering the phone. Our research partner Southwick Associates surveyed 300 participants via phone from South Carolina, but did not report compliance rates. This study was approved by the Human Subjects Institutional Review Board of North Carolina State University (protocol #24355).

Questionnaire Development

We consulted with NC Wildlife Resources Commission biologists to ensure that questionnaire language and content was factually correct and appropriate. We pretested the questionnaire with 200 randomly selected hunters from the same population as the main survey, 121 of whom received an email link and 79 of whom received a postcard to complete our survey. Then, we conducted cognitive interviews with 10 additional hunters (Desimone and Le Floch, 2004; Peterson et al., 2017; Casola et al., 2020; Valdez et al., 2018) whom we knew through personal acquaintances (graduate students, faculty, etc.). We told each interviewee the purpose of our study and our expectations of them before we asked if they agreed to participate in the cognitive interview. These interviews included discussing each question with participants to iteratively improve alignment between the research team's intended meaning of questions and interpretations of question meaning among the participants (Willis, 2005; Casola et al., 2020). These discussions included asking the participant to voice their inner monologue as they completed the

questionnaire and asking them to identify and correct issues associated with wording, question comprehension, and skip patterns (Dalrymple et al., 2010; Burke et al., 2019).

Online Survey

We individually measured WTP for CWD testing and WTP for safe disposal of a CWD-infected carcass with an open-ended question. Before we asked participants WTP for CWD testing and disposal questions, we primed them with the following context:

"Testing harvested deer for CWD and disposing of CWD infected carcasses in a safe way can be an expensive part of effective CWD management. Safe disposal of deer carcasses that are infected with CWD requires burial, incineration, or using a sanitary landfill. In the following questions, please think about how important testing and carcass disposal is to you and how much you would be willing to pay for these management activities."

We then asked the participant if they were willing to pay a fee to get a deer that they harvested tested for CWD. If the participant said "yes," we asked "How much would you be willing to pay to get a deer you harvested tested for CWD?" as an open-ended question. After the questions on CWD testing, we applied the same approach towards determining hunter willingness to pay for CWD disposal. We asked the participants if they were willing to pay a fee to safely dispose of the carcass if they harvested a deer in a county in which CWD was prevalent. If the participant said "yes," we asked "How much would you be willing to pay to safely dispose of the carcass?" as an open-ended question. Participants were not required to answer any of these four WTP questions.

All participants were asked to indicate their gender identity (male, female, or other), age (phrased as what year they were born), education (less than a high school diploma, high school or GED, college degree, or advanced degree beyond 4-year degree), political identity (assessed using a 5-point scale, adapted from Casola et al. (2020) and Beall et al. (2021), ranging from very conservative to very liberal), and current approximate annual household income before taxes (i.e., Less than $10,000, $10,000 - $29,999, $30,000 -

$49,999, $50,000 - $69,999, $70,000 - $89,999, $90,000 - $99,999, $100,000 - $124,999, $125,000 - $149,999, and $150,000 or more).

For South Carolina's online survey instrument, we used the same questions as North Carolina's online survey instrument. This enabled us to make direct comparisons between states during analyses. The only changes to the survey questions were made to reflect that this questionnaire was intended for South Carolina and not North Carolina (i.e., changing NC to SC in the question stems). An unexpected new detection of CWD in North Carolina forced us to make several small changes to the online survey instrument during data collection. First we replaced "In the following questions, please think about how important testing and carcass disposal is to you and how much you would be willing to pay for these management activities if CWD is detected in North Carolina." with "In the following questions, please think about how important testing and carcass disposal is to you and how much you would be willing to pay for these management activities." in the priming paragraph about the importance of testing and disposal after 343 responses were recorded in North Carolina. Similarly, we replaced "Imagine that Chronic Wasting Disease is detected in North Carolina and testing centers were established. Would you be willing to pay a fee to get a deer that you harvested tested for CWD?" with "Would you be willing to pay a fee to get a deer that you harvested tested for CWD?" Lastly, we changed "If Chronic Wasting Disease is detected in North Carolina, how much would you be willing to pay to get a deer you harvested tested for CWD?" to be "How much would you be willing to pay to get a deer you harvested tested for CWD?" The instruments in both states were completely identical outside these three changes made in North Carolina after the first 343 responses.

Phone Survey

The phone survey consisted of a subset of questions from the online survey, including the open-ended WTP questions, and a set of dichotomous choice contingent valuation questions to estimate the non-market value of CWD testing and disposal (Hanemann et al., 1991). For the dichotomous choice questions, we presented randomized initial bid amounts from a pre-selected set of values between $5 and $25

(specifically, $5, $10, $15, $20, and $25). These amounts were suggested by the biologists at the NCWRC based on both the cost of testing during the study time period and what they considered realistic fee amounts. If the respondent said "yes" to the initial bid amount, we presented a follow-up question with a second bid that was randomly selected from the selection of larger values. If the respondent said "no" to the initial bid amount, the randomly selected follow-up bid we provided was a lower amount. This dichotomous choice methodology produced intervals within which the respondent's true WTP amount was nested (Casola, 2022). For example, if the respondent said yes to the initial bid of $10 and no to a follow-up bid of $20, then we would know their true WTP is between $10 and $20. After the questions on CWD testing, we applied the same approach towards determining their willingness to pay for CWD disposal. We asked the participant if they were willing to pay a fee for safe disposal if they harvested a deer in a county in which CWD was prevalent. If the participant said "yes," we would ask them the WTP bid questions. We used the same values of $5, $10, $15, $20, and $25 for the disposal questions.

Data Analysis

Firstly, we calculated the number of respondents who were willing to pay for both CWD testing and disposal using descriptive statistics (e.g., counts and percentages). For the remaining analyses, data preparation entailed removing participants who said "no" to the questions "Would you be willing to pay a fee to get a deer that you harvested tested for CWD?" or "If you harvested a deer in a county where CWD was detected, would you be willing to pay a fee to safely dispose of the carcass?". We removed these participants because we believed it would be more intuitive to present the WTP estimate from those who indicated that they are willing to pay at least $1 while acknowledging the percentage of people not willing to pay (rather than presenting WTP estimates that included participants who are willing to pay $0). We used histograms to represent the distribution of values that participants reported they were willing to pay for CWD testing and safe disposal on both our online and phone surveys.

To analyze the open-ended responses, we used linear regression models. First, we fit linear regression models (R Core Team, 2021) to estimate the effect of specific demographic parameters of the

respondents in our sample (i.e., gender, education level, age). Then, we used the linear regression models to predict specific values for mean WTP for testing and disposal for the average respondent from the open-ended questions on our online survey (i.e., male, college-educated, 52 years old) and phone survey (i.e., male, college-educated, 46 years old) (Research Question 1).

Using the dichotomous choice responses for WTP for CWD testing and disposal, we fit a parametric accelerated failure time model using the 'survival' package in R (R Core Team, 2021; Therneau, 2021). This allowed us to create an interval censored regression model that estimated parameters by maximum likelihood. A gaussian distribution was used in the final analysis because it has a strong theoretical foundation within WTP studies (Dalrymple et al., 2012; Hadisoemarto and Castro, 2013; Nunes, 2002; Ressurreição et al., 2011; Simpson and Hanna, 2010). The natural log of the WTP interval was modeled as a function of gender (indicator: female = 0, male = 1), age (a continuous variable), and education level (indicator: no college = 0, college = 1). We used the interval censored regression model to predict mean WTP for testing and disposal from the dichotomous choice questions on our phone survey (Research Question 1).

For both survey modes and CV methodologies, we generated a mean WTP estimate and associated 95% confidence intervals. To compare WTP value estimates for testing and disposal across survey mode and CV method, we used 95% confidence intervals to determine whether they were statistically different (Research Question 2). To determine if the average WTP estimates of those who were willing to pay for testing and safe disposal were statistically different between survey modes, we controlled for CV methods by comparing our estimates from only the open-ended questions from our online and phone surveys. To determine if the average WTP estimates of those who were willing to pay for testing and disposal were statistically different between CV methods, we controlled for mode by comparing our estimates from the dichotomous choice and open-ended questions on our phone survey only.

We used linear regression models to examine associations between demographic variables and our two dependent variables: (1) WTP amounts for testing reported from the open-ended questions on the online and phone surveys and (2) WTP amounts for disposal reported from the open-ended questions on the online

and phone surveys (Research Question 3). For the online survey, the demographic attributes included gender, which was coded as a dummy variable (with males as 1 and females as 0), age (treated as a continuous variable, representing participants' ages ranging from 18 to 88), education level (which was coded as a categorical variable from 1 being Less than high school diploma to 4 being Advanced degree beyond 4-year degree), political identity (in which Moderates/Liberals were coded as 0 and Conservatives were coded as 1), income level (which was coded as a categorical variable from 1 being Less than $10,000 to 9 being $150,000 or more), and state (which was coded as a dummy variable with North Carolina being 1 and South Carolina being 0). For the phone survey, the demographic attributes only included gender, age (representing participants' ages ranging from 19 to 87), and education level. Prior to interpreting models, we tested for assumptions of multicollinearity in our regression models using variance inflation factors (VIFs) (Craney and Surles, 2002). Tests indicated low levels of multicollinearity between all variables (VIF < 2.0 for each variable). We assessed model fit with R^2. Wherever possible, we used pairwise exclusion for missing values to maximum use of available information in analyses.

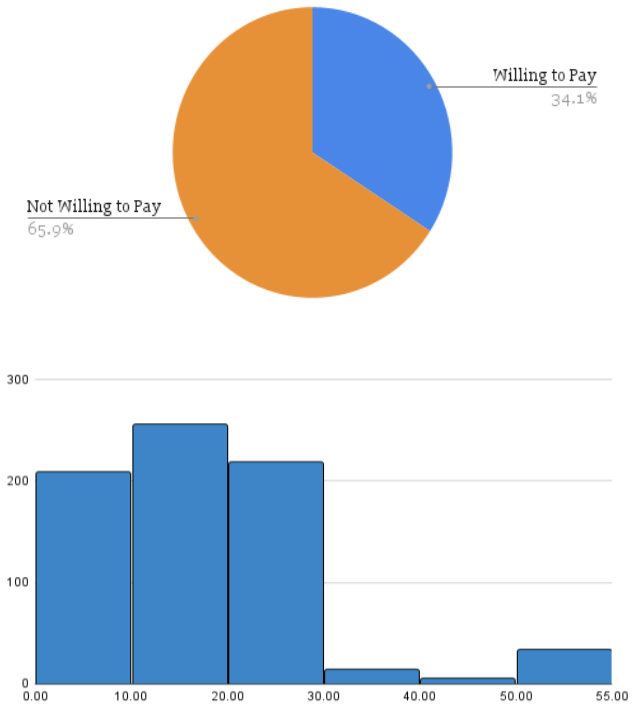
We tested for non-response bias in our sample by comparing the data we obtained from our online survey with the data we obtained from our phone survey using independent samples t-tests for numerical data (Lawson et al., 2019) and chi-square tests for categorical data (Etter and Perneger, 1997; Reisen in witz, 2016). Respondents from our phone sample were younger than those from our online survey sample (mean age 46 vs. 54, $t(1850) = 10.89$, $p < 0.001$), were slightly more likely to be female (6.2% vs. 6.0%, $X^2(1, 1875) = 0.024$, $p = 0.876$), and less likely to have obtained a college degree (66.1% college degree vs. 74.9%, $X^2(1, 1849) = 15.252$, $p < 0.001$). Despite significant differences, all of the effect sizes for these relationships were small (i.e., below the 0.6 threshold for medium effect size for Cohen's *D* for t-tests (Lovakov and Agadullina, 2021) and below the 0.1 threshold for Phi for chi-square tests (Kotrlik et al., 2011), thus we decided that weighting was not necessary. We conducted the analyses to predict WTP estimates using R (R Core Team, 2021) and the analyses to evaluate the relationships with demographic attributes using SPSS Statistics (IBM Corp).

Results

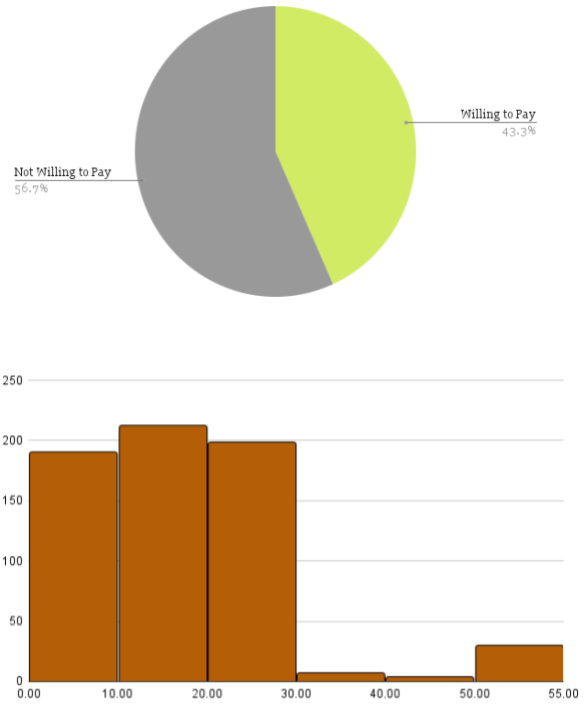
Respondents to both the online survey and phone survey were predominantly male (85% and 91.2%, respectively). Most respondents to both the online survey (67%) and phone survey (52.3%) reported having a college degree (2-year Associate's degree/4-year college degree or higher). The average age among respondents in our online sample was 54.1 years old (*SD* = 14.7) and 45.9 years old (*SD* = 15.3) for our phone sample. The number of respondents who completed our WTP questions was 1320 from our online survey (110 item nonresponse) and 577 from our phone survey (26 item nonresponse).

Figure 2.1. Multi-panel figure with pie charts and histograms. Pie charts indicate how many people are willing to pay for CWD testing and safe disposal across both survey modes. Histograms show the distribution of amounts that people reported they were willing to pay for testing and disposal on the open-ended questions across survey modes.

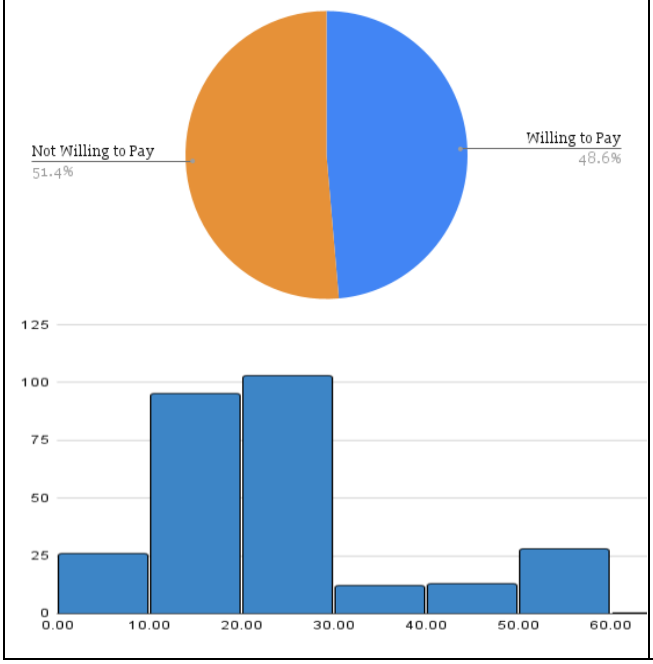
Online Survey – Testing



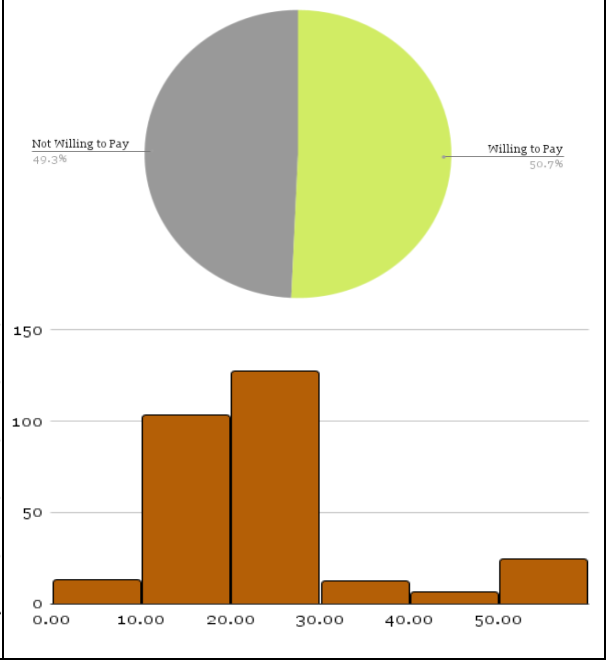
Online Survey - Disposal



Phone Survey - Testing



Phone Survey - Disposal



On average, less than half of the hunters were willing to pay for testing (34.1% for online survey; 48.6% for phone survey; **Figure 2.1.**) and disposal (43.3% for online survey; 50.7% for phone survey; **Figure 2.1.**). For our online survey, most participants reported WTP values between $10-$20 and for our phone survey, most participants reported WTP values between $20-$30 (**Figure 2.1.**).

Based on predicted means for the average survey participant in our sample, respondents to the open-ended CV questions on the online survey were willing to pay lower amounts for testing ($15.96; 95% CI [0 - 49.83]; **Figure 2.2, Table 2.1.**) and disposal ($14.74; 95% CI [0 - 39.02;] **Figure 2.2, Table 2.1.**) compared to respondents who answered our open-ended questions on the phone survey (testing; $22.90; 95% CI [0 - 53.42]; disposal $22.80; 95% CI [0 - 51.69]; **Figure 2.2, Table 2.1.**) Although the mean point estimates of WTP were lower for the online survey than the phone survey, all the estimates had overlapping confidence intervals. Based on predicted means, respondents to the open-ended questions were willing to pay nearly identical amounts for testing ($22.90; 95% CI [0 - 53.42]; **Figure 2.2, Table 2.1.**) and disposal ($22.80; 95% CI [0 - 51.69]; **Figure 2.2, Table 2.1.**) to the amounts reported from the dichotomous choice CV questions (testing: $24.80, 95% CI [23.31 - 26.29]; disposal: $24.50, 95% CI [23.11 - 25.89]; **Figure 2.2, Table 2.1.**)

Figure 2.2. Predicted means of willingness to pay (WTP) estimates for those who indicated that they were willing to pay for CWD testing and safe disposal practices. These means were calculated from inputting the demographic attributes of the "average" respondent in our pooled North Carolina and South Carolina sample. The means were obtained by fitting an interval censored regression from the open-ended and dichotomous choice data presented on the online survey and phone survey. Error bars indicate a 95% confidence interval.

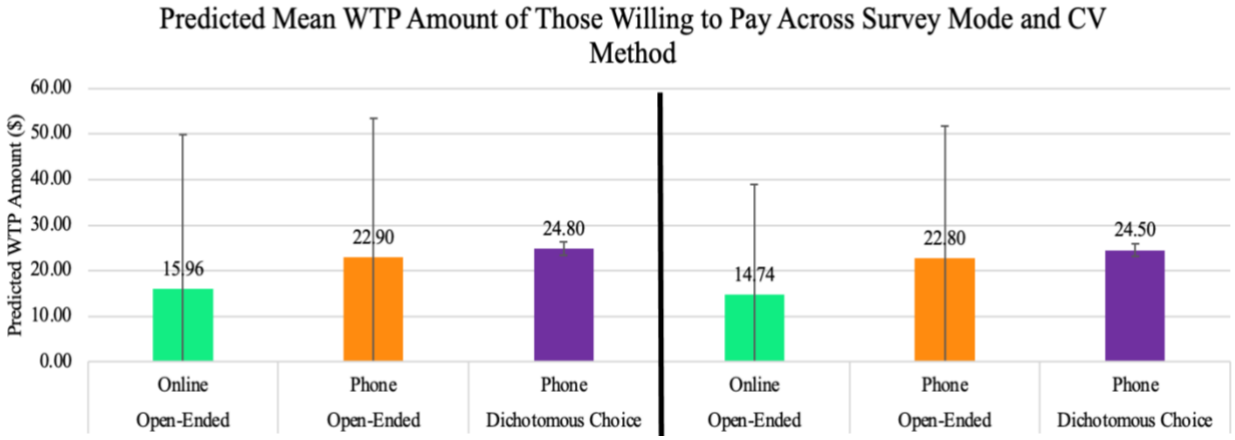


Table 2.1. Predicted means of willingness to pay (WTP) estimates for testing and safe carcass disposal practices. These means were calculated from our pooled North Carolina and South Carolina open-ended question data presented on the online survey and phone survey and the pooled dichotomous choice data presented on the phone survey only.

Management Practice	Method	Survey Mode	Predicted Average ($)	95% CI
Testing	Open-Ended	Online	15.96	[0 - 49.83]
Testing	Open-Ended	Phone	22.90	[0 - 53.42]
Testing	Dichotomous Choice	Phone	24.80	[23.31 - 26.29]
Disposal	Open-Ended	Online	14.74	[0 - 39.02]
Disposal	Open-Ended	Phone	22.80	[0 - 51.69]
Disposal	Dichotomous Choice	Phone	24.50	[23.11 - 25.89]

Our models looking at the effect of demographic variables on WTP for testing and disposal had low predictive power (Adj. $R^2 < 0.020$). However, as hunters became more liberal, they reported higher WTP for CWD testing on the online survey (B = -0.13, p = .001; **Table 2.2.**). As hunters became older, they reported lower WTP for CWD testing on the phone survey (B = -0.16, p = 0.008; **Table 2.3.**). We did not detect statistically significant relationships between demographic variables and WTP for safe disposal of carcasses (**Tables 2.2, 2.3.**).

Table 2.2. Parameter estimation from a linear Regression Model Examining Demographic Variables Associated with North and South Carolina hunters' WTP for CWD Testing asked via the Open-Ended Question on our Online Survey (n = 488)[a] and Disposal asked on our Online Survey (n = 620)[b].

	Testing				Disposal			
Variable	*B*	*SE*	*Standardized B*	*p-value*	*B*	*SE*	*Standardized B*	*p-value*
Constant	14.71	5.06	–	0.004	12.02	3.73	–	0.001
Gender	0.71	2.82	0.01	0.80	0.11	1.99	0.002	0.96
Age	-0.03	0.05	-0.02	0.59	0.02	0.04	0.02	0.63
Education	0.88	1.03	0.04	0.39	0.25	0.81	0.01	0.76
Political identity	-4.57	1.58	-0.11	0.004	-1.30	1.21	-0.05	0.29
Income	0.43	0.34	0.05	0.21	0.36	0.26	0.06	0.17
State	0.53	1.42	0.01	0.71	-0.57	1.09	-0.02	0.60

[a]$R^2 = 0.018$
[b]$R^2 = 0.007$

Table 2.3. Parameter estimation from a linear Regression Model Examining Demographic Variables Associated with North and South Carolina hunters' WTP for CWD Testing asked via the Open-Ended Question on our Phone Survey (n = 293)[a] and Disposal asked on our Phone Survey (n = 306)[b].

	Testing				Disposal			
Variable	*B*	*SE*	*Standardized B*	*p-value*	*B*	*SE*	*Standardized B*	*p-value*
Constant	21.80	5.98	–	<0.001	21.76	5.54	–	<0.001
Gender	5.85	3.47	0.10	0.09	-3.15	3.42	-0.05	0.36
Age	-0.16	0.06	-0.16	0.01	-0.08	0.06	-0.08	0.18
Education	0.60	1.48	0.02	0.69	2.34	1.38	0.10	0.09
State	1.43	1.89	0.05	0.45	1.01	1.78	0.03	0.57

[a]$R^2 = 0.033$
[b]$R^2 = 0.020$

Discussion

Although previous studies have measured WTP for CWD management (Zimmer et al., 2012; Ufer et al., 2022; Adhikari et al., 2022), our study is novel because it addresses how survey mode and CV method influence WTP for CWD management actions. Our findings suggest that, when estimating WTP for CWD management, and possibly other non-market goods, survey mode (web vs. phone) impacts results, but method (open-ended vs. dichotomous choice) may not.

Social desirability bias and anchoring may explain why phone survey estimates of WTP were higher than online survey estimates (Holbrook and Krosnick, 2010). Other studies have demonstrated similar patterns, with people indicating that they are willing to pay more money when asked in a way that requires direct interactions with researchers (Lindberg et al., 1997; Whitaker et al., 1998; Leggett et al., 2003). Priming effects may also explain differences between phone and online estimates of WTP. Priming respondents by asking questions about WTP and even suggesting potential price ranges is considered a best practice for CV (Johnston et al., 2017), but in this study only the phone respondents received priming with specific dollar amounts (i.e., the values presented in the dichotomous choice questions they received prior to the open-ended questions). If this did occur, then respondents might have been primed to consider relatively low values between $5 (the lowest bid we offered) and $25 (the highest bid we offered). This study suggests open-ended CV models may be resistant to these biases when employed in wildlife management contexts.

Several factors may explain why the WTP estimates for testing and disposal were nearly identical in dichotomous choice and open-ended approaches. First, bias that occurs due to the absence of cues indicating plausible values (Frew et al., 2003) may have less impact because the respondents from our phone survey were primed from the values provided in our dichotomous choice questions that they answered before the open-ended questions. Second, strategic bias (Flyvbjerg, 2021; Doyon and Bergeron, 2016) may have less impact because the respondents believed that the amounts asked about in our dichotomous choice questions were already vetted by the state agency that sponsored the survey. Therefore, respondents might not have been inclined to report lower amounts when responding to the open-ended questions even though lower costs would be more favorable to them. Although the cognitive

burden of coming up with a WTP estimate has been linked to respondents reporting small amounts in open-ended questions (Mitchell and Carson, 2013; McCollum and Miller 1994; Brown et al., 1996), this might not have been an issue in our survey. Since we asked the respondents the open-ended WTP questions last, they were familiar with the context of the questions and possible costs for CWD testing and disposal practices. This could have reduced the cognitive burden of the respondents coming up with their own WTP estimate (Mitchell and Carson, 2013; McCollum and Miller, 1994; Brown et al., 1996). Lastly, the open-ended questions created WTP estimates with more variance than the dichotomous choice questions, likely because respondents could answer with very high values if they chose to do so (Burchell and Marsh, 1992).

Collectively, a growing number of studies on WTP for CWD management suggest hunters exhibit similar WTP for diverse types of management and safety protocols across most regions where CWD has been detected. To facilitate comparisons between our results and previous work, we present estimates in 2020 USD (Bureau of Labor Statistics, 2010). Hunters in North Carolina and South Carolina, on average, were willing to pay approximately $15-$25 for both CWD testing and safe disposal, which is similar to other studies that have evaluated hunters' willingness to pay for CWD-related management efforts in different locations. Canadian hunters' average WTP for practices that could be applied towards CWD management, such as culling, was $23.81 (Zimmer et al., 2012). We propose that this WTP amount is higher than the estimates we found in our study because at the time that Zimmer et al. (2012) collected data, there was a higher prevalence of CWD in Alberta than there was in North and South Carolina. Due to the close proximity of the disease, hunters might have been more willing to contribute more financial backing to the management of CWD (Kayamo, 2022). Hunters in Tennessee reported paying up to $22.99 per deer on average for a voucher that would waive the processing fee if they previously brought in an infected deer to wildlife agencies as a way to encourage hunter participation in CWD-impacted areas (Adhikari et al., 2022). Other research suggests hunters from the United States and Canada, on average, are willing to pay between $13.40 and $25.66 for a voluntary CWD stamp that would support a program providing funding for the management and control of CWD (Ufer et al., 2022). Our results seem to be

consistent with the values that hunters in other states and countries reported being willing to pay to prevent CWD. There could be two potential explanations for the similarity of CWD WTP estimates reported. Firstly, this range of values could indicate what hunters would pay to adjust their hunting behavior to accommodate management of CWD. These amounts could represent the incremental loss to the hunting experience that hunters believe is justified, if it means potentially stopping the spread of CWD. Although, since the long-term efficacy of any managerial intervention for CWD is uncertain, there isn't a known set cost to preserving the opportunity for hunting. Therefore, hunters appear to think that the perceived opportunity cost of mitigating CWD is in the range of $15-$25 even with the uncertainty of the interventions proposed in this study. Secondly, hunters might suggest values in the range of $15-$25 because it is similar to license fees or other familiar fees administered by the state agency. For example, the cost of an annual hunting license for a resident of North Carolina is $25 (North Carolina Hunting (n.d.).). However, the relatively low WTP estimates present a challenge to state wildlife agencies that are paying up to $560 for each sample tested, with the average amount among 33 state agencies being $144 for all field operations necessary to obtain and test one sample (Thompson and Mason, 2022).

Only a few of the demographic attributes considered in this study were associated with a hunter's WTP for CWD management, and these associations were relatively weak. Hunters' political identity influenced their willingness to pay for CWD testing, with those who identified as moderate or liberal reporting a higher willingness to pay. We tested for differences in annual household income and education levels between conservative and moderate/liberal hunters, since these variables have predicted WTP in previous studies (Jacques, 2023). Since the difference in income was insignificant and the difference in education level had a low effect size (Lovakov and Agadullina, 2021), we suggest that there were other factors to account for the discrepancy in reported WTP values among conservatives and moderates/liberals. However, this finding aligns with previous natural resources research, in which respondents who self-identified as possessing a liberal political ideology were more willing to pay for a program designed to benefit drinking water quality (Nielsen-Pincus et al., 2017) and more willing to pay for environmental taxes (Fairbrother, 2019). We also found that hunters' age can predict their WTP for testing. Younger hunters

were willing to pay more for CWD testing, which is consistent with findings that evaluated visitors of national parks and protected areas' WTP to provide economic support for nature conservation (Aseres and Sira, 2020; Platania and Rizzo, 2018; Witt, 2019; Haefele et al., 2019). Although the findings suggest some associations with demographic attributes, the predictive power of the model was low indicating the value of CWD management activities may have been relatively independent of socio-demographic variables, or that other factors (e.g., risk perception and knowledge) play an important role. Previous research on CWD management, however, suggests most predictors including risk and knowledge have relatively low predictive power (Vaske et al., 2022).

Future research could address some limitations of our study. As noted above, the order of questions on our phone survey (i.e., dichotomous choice first, open-ended second) could have had an anchoring effect on the respondents. Investigators in a future study could administer a survey that is similar to ours, but with a randomized question design that lowers the risk of priming respondents about valid estimates for CWD testing and disposal costs. Researchers could either ask the open-ended WTP questions before the dichotomous choice questions or split their sample so that half of the respondents receive the open-ended questions and the other half receive the dichotomous choice questions. Also, since the WTP estimates from the open-ended questions had more variance than those from the dichotomous choice questions, we might need to transform our dependent variables in our open-ended regression models to account for this (Lütkepohl and Xu, 2012). Another study is needed to investigate the reasons why hunters in North Carolina and South Carolina chose values in the range of $15-$25, just as other researchers have inquired about their study respondents' motivations for their reported WTP estimates (Chen and Jim, 2010; Martín-López et al., 2007). Lastly, we think that the COVID-19 pandemic might have altered how people decide on their WTP estimates for wildlife disease (Beall et al., 2021). Therefore, we suggest that researchers who have conducted similar CV studies on wildlife disease pre-2020 can either repeat them or follow-up on them to determine the effect, if any, that the COVID-19 context has on people's WTP. Similarly, since the causative agent of COVID-19 (SARS-CoV-2) has been found in white-tailed deer populations (Chandler et al., 2021; Gao and Wang, 2021; Palmer et al., 2021),

future studies on the effect that this has on WTP for prevention of COVID-19 in deer might provide insight into how the pandemic changed the CV landscape for wildlife disease.

Conclusion

This study has implications for both researchers and wildlife state agencies. Our findings show that survey mode can influence how people respond to questions about their WTP, with online formats permitting more privacy that enables participants to state lower - and perhaps more honest - estimates for their WTP compared to phone surveys that introduce an element of social desirability bias. Our findings also suggest that researchers could use the open-ended approach, in place of the dichotomous choice approach, and still obtain valid and appropriate estimates for non-market goods and services that could assist in controlling the spread of wildlife diseases. However, if managers adopt an open-ended approach, they should be aware of the greater variation of responses they might receive. This can be helpful to researchers since the open-ended CV approach is an easier and more efficient way to estimate hunters' WTP. These findings can be of use to researchers and managers who are trying to implement CWD response plans with an economic impact analysis component. Also, our study provided more evidence that hunters are typically willing to pay between $15 and $25 for CWD testing and disposal, mirroring results in states where CWD has been around longer and is more prevalent. Since this range is below the actual cost of implementing these disease management practices, wildlife managers may need to consider more cost-friendly alternatives or other funding resources to supplement the amount that hunters would be willing to pay for CWD testing and disposal.

Data Availability

The datasets used for the analyses of this study are not accessible because the Institutional Review Board prohibits the distribution of data related to human subjects. Requests to access the data should be directed to Catherine Sam Lerose, cslerose@ncsu.edu.

Conflict of Interest

There are no conflicts of interests among the authors of this paper.

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REFERENCES

Adhikari, R. K., Poudyal, N. C., Muller, L. I., & Yoest, C. (2022). Hunters' Willingness to Pay to Avoid Processing Costs Associated with Harvesting Infected Game. *Journal of Agricultural and Applied Economics*, *54*(1), 93-113.

Alvarez-Farizo, B., Hanley, N., Wright, R. E., & Macmillan, D. (1999). Estimating the benefits of agri-environmental policy: Econometric issues in open-ended contingent valuation studies. *Journal of Environmental Planning and Management*, *42*(1), 23-43. doi:https://doi.org/10.1080/09640569911280

Arbiol, J., Borja, M., Yabe, M., Nomura, H., Gloriani, N., & Yoshida, S. (2013). Valuing human leptospirosis prevention using the opportunity cost of labor. *International journal of environmental research and public health*, *10*(5), 1845-1860.

Aseres, S. A., & Sira, R. K. (2020). Estimating visitors' willingness to pay for a conservation fund: sustainable financing approach in protected areas in Ethiopia. *Heliyon*, *6*(8), e04500.

Baker, R., & Downes-Le Guin, T. (2007, September). Separating the wheat from the chaff: ensuring data quality in internet samples. In *Proceedings of the fifth international conference of the association for survey computing: the challenges of a changing world* (pp. 157-166).

Ball, H. L. (2019). Conducting online surveys. *Journal of human lactation*, *35*(3), 413-417.

Barnes, J. I., Schier, C., & Van Rooy, G. (1999). Tourists' willingness to pay for wildlife viewing and wildlife conservation in Namibia. *South African Journal of Wildlife Research-24-month delayed open access*, *29*(4), 101-111.

Bateman, I., Willis, K., & Garrod, G. (1994). Consistency between contingent valuation estimates: a comparison of two studies of UK National Parks. *Journal of the Regional Studies Association*, *28*(5), 457-474.

Beall JM, Casola WR, Peterson MN, Larson LR, Carr WA, Seekamp E, Stevenson KT and Jackson SB (2021) Cultural Cognition and Ideological Framing Influence Communication About Zoonotic Disease in the Era of COVID-19. *Front. Commun.* 6:645692. doi: 10.3389/fcomm.2021.645692

Bland, J. M., & Altman, D. G. (1997). Statistics notes: Cronbach's alpha. *Bmj*, *314*(7080), 572.

Brown, T., Champ, P., Bishop, R. & McCollum, D. (1996) Response formats and public good donations, Land Economics, 72(2), pp. 152-166.

Brown, T. C., Champ, P. A., Bishop, R. C., & McCollum, D. W. (1996). Which response format reveals the truth about donations to a public good?. *Land Economics*, 152-166.

Bureau of Labor Statistics. 2010. CPI inflation calculator. <http://www. bls.gov/data/inflation_calculator.htm>. Accessed 18 Nov 2010.

Bureau, W. L. A. (2006). An Evaluation, Chronic Wasting Disease, Department of Natural Resources. *Madison, WI: Wisconsin Legislative Audit Bureau report*, 06-13.

Carlson, C. M., Hopkins, M. C., Nguyen, N. T., Richards, B. J., Walsh, D. P., & Walter, W. D. (2018). *Chronic wasting disease: status, science, and management support by the US Geological Survey*. US Department of the Interior, US Geological Survey.

Casola, W. R., Beall, J. M., Nils Peterson, M., Larson, L. R., Brent Jackson, S., & Stevenson, K. T. (2022). Political polarization of conservation issues in the era of covid-19: An examination of partisan perspectives and priorities in the United States. *Journal for Nature Conservation*, *67*, 126176. https://doi.org/10.1016/j.jnc.2022.126176

Cocheba, D. J., & Langford, W. A. (1978). Wildlife valuation: the collective good aspect of hunting. *Land economics*, *54*(4), 490-504.

Cummings, R. G., Harrison, G. W., & Rutström, E. E. (1995). Homegrown values and hypothetical surveys: is the dichotomous choice approach incentive-compatible?. *The American Economic Review*, *85*(1), 260-266.

Dalrymple, C.J., Peterson, M.N., Cobb, D.T., Sills, E.O., Bondell, H.D., Dalrymple, D.J., 2012.
466 Estimating public willingness to fund nongame conservation through state tax initiatives.
467 Wildl Soc Bull 36, 483–491. https://doi.org/10.1002/wsb.164

Davis, J. (2004). Assessing community preferences for development projects: are willingness-to-pay studies robust to mode effects?. *World Development*, *32*(4), 655-672.

Dorak, S. J., Varga, C., Ruder, M. G., Gronemeyer, P., Rivera, N. A., Dufford, D. R., ... & Mateus-Pinilla, N. E. (2022). Spatial epidemiology of hemorrhagic disease in Illinois wild white-tailed deer. *Scientific reports*, *12*(1), 6888.

Elkstrand, E., & Loomis, J. (1997). Estimated willingness to pay for protecting critical habitat for threatened and endangered fish with respondent uncertainty. *Englin, J.(Compiler), Tenth Interim Report, W-133 Benefits and Costs Transfer in Natural Resource Planning, University of Reno, Reno, NV*.

Esch, K. J., Pontes, N. N., Arruda, P., O'Connor, A., Morais, L., Jeronimo, S. M., & Petersen, C. A. (2012). Preventing zoonotic canine leishmaniasis in northeastern Brazil: pet attachment and adoption of community leishmania prevention. *The American journal of tropical medicine and hygiene*, *87*(5), 822.

Fairbrother, M. (2019). When will people pay to pollute? Environmental taxes, political trust and experimental evidence from Britain. *British Journal of Political Science*, *49*(2), 661-682.

Fischer, A., Tibebe Weldesemaet, Y., Czajkowski, M., Tadie, D., & Hanley, N. (2015). Trophy hunters' willingness to pay for wildlife conservation and community benefits. *Conservation biology*, *29*(4), 1111-1121.

Frew, E. J., Whynes, D. K., & Wolstenholme, J. L. (2003). Eliciting willingness to pay: comparing closed-ended with open-ended and payment scale formats. *Medical decision making*, *23*(2), 150-159.

Frew, E. J., Wolstenholme, J. L., & Whynes, D. K. (2004). Comparing willingness-to-pay: bidding game format versus open-ended and payment scale formats. *Health Policy*, *68*(3), 289-298.

Gao, Z., House, L., & Bi, X. (2016). Impact of satisficing behavior in online surveys on consumer preference and welfare estimates. *Food Policy*, *64*, 26-36.

Gao, Z., House, L. A., & Xie, J. (2016). Online survey data quality and its implication for willingness-to-pay: A cross-country comparison. *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie*, *64*(2), 199-221.

Gren, I. M., Häggmark-Svensson, T., Elofsson, K., & Engelmann, M. (2018). Economics of wildlife management—an overview. *European Journal of Wildlife Research*, *64*, 1-16.

Hadisoemarto, P.F., Castro, M.C., 2013. Public Acceptance and Willingness-to-Pay for a Future
485 Dengue Vaccine: A Community-Based Survey in Bandung, Indonesia. PLoS Negl Trop Dis
486 7, e2427. https://doi.org/10.1371/journal.pntd.0002427

Haefele, M. A., Loomis, J. B., Lien, A. M., Dubovsky, J. A., Merideth, R. W., Bagstad, K. J., ... & López-Hoffman, L. (2019). Multi-country willingness to pay for transborder migratory species conservation: A case study of northern pintails. *Ecological Economics*, *157*, 321-331.

Hammitt, J. K., Liu, J. T., & Liu, J. L. (2001). Contingent valuation of a Taiwanese wetland. *Environment and Development Economics*, *6*(2), 259-268.

Hanemann, W. M. (1985). Some issues in continuous-and discrete-response contingent valuation studies. *Northeastern Journal of Agricultural and Resource Economics*, *14*(1), 5-13.

Hanemann, M., Loomis, J., & Kanninen, B. (1991). Statistical efficiency of double-bounded dichotomous choice contingent valuation. *American journal of agricultural economics*, *73*(4), 1255-1263.

Häsler, B., Gilbert, W., Jones, B. A., Pfeiffer, D. U., Rushton, J., & Otte, M. J. (2013). The economic value of One Health in relation to the mitigation of zoonotic disease risks. *One Health: The Human-Animal-Environment Interfaces in Emerging Infectious Diseases: The Concept and Examples of a One Health Approach*, 127-151.

Heffelfinger, J. R., Geist, V., & Wishart, W. (2013). The role of hunting in North American wildlife conservation. *International Journal of Environmental Studies*, *70*(3), 399-413.

Hoehn, J. P., & Randall, A. (1999). A satisfactory benefit cost indicator from contingent valuation. In *Making the Environment Count* (pp. 110-131). Edward Elgar Publishing.

Holbrook, A. L., & Krosnick, J. A. (2010). Social desirability bias in voter turnout reports: Tests using the item count technique. *Public opinion quarterly*, *74*(1), 37-67.

Horan, R. D., & Wolf, C. A. (2005). The economics of managing infectious wildlife disease. *American Journal of Agricultural Economics*, *87*(3), 537-551.

Hoyos, D., & Mariel, P. (2010). Contingent valuation: Past, present and future. *Prague economic papers*, *4*(4), 329-343.

Hunter, P. D., Hanley, N., Czajkowski, M., Mearns, K., Tyler, A. N., Carvalho, L., & Codd, G. A. (2012). The effect of risk perception on public preferences and willingness to pay for reductions in the health risks posed by toxic cyanobacterial blooms. *Science of the total environment*, *426*, 32-44.

Jacobson, C. A., Organ, J. F., Decker, D. J., Batcheller, G. R., & Carpenter, L. (2010). A conservation institution for the 21st century: implications for state wildlife agencies. *The Journal of Wildlife Management*, *74*(2), 203-209.

Johansson, M., Sjöström, M., Karlsson, J., & Brännlund, R. (2012). Is human fear affecting public willingness to pay for the management and conservation of large carnivores?. *Society & Natural Resources*, *25*(6), 610-620.

Kaffashi, S., Yacob, M. R., Clark, M. S., Radam, A., & Mamat, M. F. (2015). Exploring visitors' willingness to pay to generate revenues for managing the National Elephant Conservation Center in Malaysia. *Forest Policy and Economics*, *56*, 9-19.

Kanninen, B. J. (1993). Optimal experimental design for double-bounded dichotomous choice contingent valuation. *Land Economics*, 138-146.

Kayamo, S. E. (2022). Willingness to pay for solid waste management improvement in Hawassa city, Ethiopia. *Journal of Environmental Management*, *302*, 113973.

Kealy, M. J., & Turner, R. W. (1993). A test of the equality of closed-ended and open-ended contingent valuations. *American journal of agricultural economics*, *75*(2), 321-331.

Kotchen, M. J., & Reiling, S. D. (2000). Environmental attitudes, motivations, and contingent valuation of nonuse values: a case study involving endangered species. *Ecological Economics*, *32*(1), 93-107.

Larson, R. B. (2019). Controlling social desirability bias. *International Journal of Market Research*, *61*(5), 534-547.

Leggett, C. G., Kleckner, N. S., Boyle, K. J., Dufield, J. W., & Mitchell, R. C. (2003). Social desirability bias in contingent valuation surveys administered through in-person interviews. *Land economics*, *79*(4), 561-575.

Lindberg, K., Johnson, R. L., & Berrens, R. P. (1997). Contingent valuation of rural tourism development with tests of scope and mode stability. *Journal of Agricultural and Resource Economics*, 44-60.

Loomis, J., & Ekstrand, E. (1997). Economic benefits of critical habitat for the Mexican spotted owl: a scope test using a multiple-bounded contingent valuation survey. *Journal of Agricultural and Resource Economics*, 356-366.

Lusk, J. L., & Hudson, D. (2004). Willingness-to-pay estimates and their relevance to agribusiness decision making. *Applied Economic Perspectives and Policy*, *26*(2), 152-169.

Lyon, K. M., & Vaske, J. J. (2010). Predicting hunting participation in response to chronic wasting disease in four states. *Human Dimensions of Wildlife*, *15*(3), 208-220.

Maguire, K. B. (2009). Does mode matter? A comparison of telephone, mail, and in-person treatments in contingent valuation surveys. *Journal of environmental management*, *90*(11), 3528-3533.

McCollum, D. W., & Miller, S. M. (1994). Alaska Voters: Their Wildlife Viewing Trip Characteristics and Economics. *Alaska Department of Fish and Game, Division of Wildlife Conservation, Anchorage*.

Mitchell, R. C., & Carson, R. T. (2013). *Using surveys to value public goods: the contingent valuation method*. Rff press.

Navrud, S., Ready, R.C., Magnussen, K., Bergland, O., 2008. Valuing the social benefits of avoiding landscape degradation from overhead power transmission lines: Do underground cables pass the benefit–cost test? Landsc Res 33, 281–296. https://doi.org/10.1080/01426390802045921

Nielsen-Pincus, M., Sussman, P., Bennett, D. E., Gosnell, H., & Parker, R. (2017). The influence of place on the willingness to pay for ecosystem services. *Society & Natural Resources*, *30*(12), 1423-1441.

Nunes, P.A.L.D., 2002. Measuring the economic benefits of protecting the Parque Natural do Sudoeste Alentejano e Costa Vicentina from commercial tourism development: results from a contingent valuation survey. Portuguese Economic Journal 1, 71–87. https://doi.org/10.1007/s10258-001-0002-8

Platania, M., & Rizzo, M. (2018). Willingness to pay for protected areas: A case of Etna Park. *Ecological Indicators*, *93*, 201-206.

Price Tack, J. L., McGowan, C. P., Ditchkoff, S. S., Morse, W. C., & Robinson, O. J. (2018). Managing the vanishing North American hunter: a novel framework to address declines in hunters and hunter-generated conservation funds. *Human Dimensions of Wildlife*, *23*(6), 515-532.

R Core Team, 2021. R: A language and environment for statistical computing.

Ressurreição, A., Gibbons, J., Dentinho, T.P., Kaiser, M., Santos, R.S., Edwards-Jones, G., 2011. Economic valuation of species loss in the open sea. Ecological Economics 70, 729–739. https://doi.org/10.1016/j.ecolecon.2010.11.009

Rivera, N. A., Brandt, A. L., Novakofski, J. E., & Mateus-Pinilla, N. E. (2019). Chronic wasting disease in cervids: Prevalence, impact and management strategies. *Veterinary Medicine: Research and Reports*, 123-139.

Ryan, M., Ratcliffe, J., & Tucker, J. (1997). Using willingness to pay to value alternative models of antenatal care. *Social Science & Medicine*, *44*(3), 371-380.

Simonson, I., & Drolet, A. (2004). Anchoring effects on consumers' willingness-to-pay and willingness-to-accept. *Journal of consumer research*, *31*(3), 681-690.

Simpson, S.N., Hanna, B.G., 2010. Willingness to pay for a clear night sky: use of the contingent valuation method. Appl Econ Lett 17, 1095–1103. https://doi.org/10.1080/00036840902817508
Therneau, T.M., 2021. A Package for Survival Analysis in R.

Smith, K., Landon, A. C., Schroeder, S. A., & McInenly, L. E. (2023). Application of the Heuristic-Systematic Model to Chronic wasting Disease Risk perceptions. *Society & Natural Resources*, 1-19.

Solikin, A. (2017). Willingness to pay and willingness to work to avoid deforestation and forest degradation. In *ICoSI 2014: Proceedings of the 2nd International Conference on Sustainable Innovation* (pp. 119-129). Springer Singapore.

Subroy, V., Gunawardena, A., Polyakov, M., Pandit, R., & Pannell, D. J. (2019). The worth of wildlife: A meta-analysis of global non-market values of threatened species. *Ecological Economics*, *164*, 106374.

Thompson, N. E., & Mason, J. R. (2022). The Cost of Combating Chronic Wasting Disease. *The Wildlife Professional*, *16*(6), 46–49.

Thulin, C. G., Malmsten, J., & Ericsson, G. (2015). Opportunities and challenges with growing wildlife populations and zoonotic diseases in Sweden. *European journal of wildlife research*, *61*, 649-656.

Tisdell, C., & Wilson, C. (2001). Wildlife-based tourism and increased support for nature conservation financially and otherwise: evidence from sea turtle ecotourism at Mon Repos. *Tourism economics*, *7*(3), 233-249.

Uehlinger, F. D., Johnston, A. C., Bollinger, T. K., & Waldner, C. L. (2016). Systematic review of management strategies to control chronic wasting disease in wild deer populations in North America. *BMC veterinary research*, *12*, 1-16.

Ufer, D. J., Christensen, S. A., Ortega, D. L., Pinizzotto, N., & Schuler, K. (2022). Stamping out wildlife disease: Are hunter-funded stamp programs a viable option for chronic wasting disease management?. *Conservation Science and Practice*, *4*(9), e12779.

Vajda, Á., Mohacsi-Farkas, C. S., Ózsvári, L., & Kasza, G. Y. (2020). Consumers's willingness to pay for avoiding Salmonella infection. *Acta Alimentaria*, *49*(1), 76-85.

Van der Pol, M., Shiell, A., Au, F., Johnston, D., & Tough, S. (2008). Convergent validity between a discrete choice experiment and a direct, open-ended method: comparison of preferred attribute levels and willingness to pay estimates. *Social science & medicine*, *67*(12), 2043-2050.

Vaske, J. J., Miller, C. A., Parent, C., & Bahnson, C. (2022). Information sources and knowledge about chronic wasting disease in North Dakota. *Human Dimensions of Wildlife*, 1-10.

Watkins, C. E., & Poudyal, N. C. (2021). The Roles of Risk Perceptions and Social Trust in Willingness to Pay for Wildlife Reintroduction. *Society & Natural Resources*, *34*(7), 847-865.

White, P. C., Bennett, A. C., & Hayes, E. J. (2001). The use of willingness-to-pay approaches in mammal conservation. *Mammal Review*, *31*(2), 151-167.

Whittaker, D., Vaske, J. J., Donnelly, M. P., & DeRuiter, D. S. (1998). Mail versus telephone surveys: Potential biases in expenditure and willingness-to-pay data. *Journal of Park and Recreation Administration*, *16*(3).

Willems, P., R. Van Ossenbruggen and T. Vonk. 2006. The effects of panel recruitment and management on research results. ESOMAR Research Paper. Barcelona, Spain, ESOMAR.org

Williams, E. S., Miller, M. W., Kreeger, T. J., Kahn, R. H., & Thorne, E. T. (2002). Chronic wasting disease of deer and elk: a review with recommendations for management. *The Journal of wildlife management*, 551-563.

Willis G. B. (2005). Cognitive interviewing: A tool for improving questionnaire design. Beverly Hills, CA: Sage

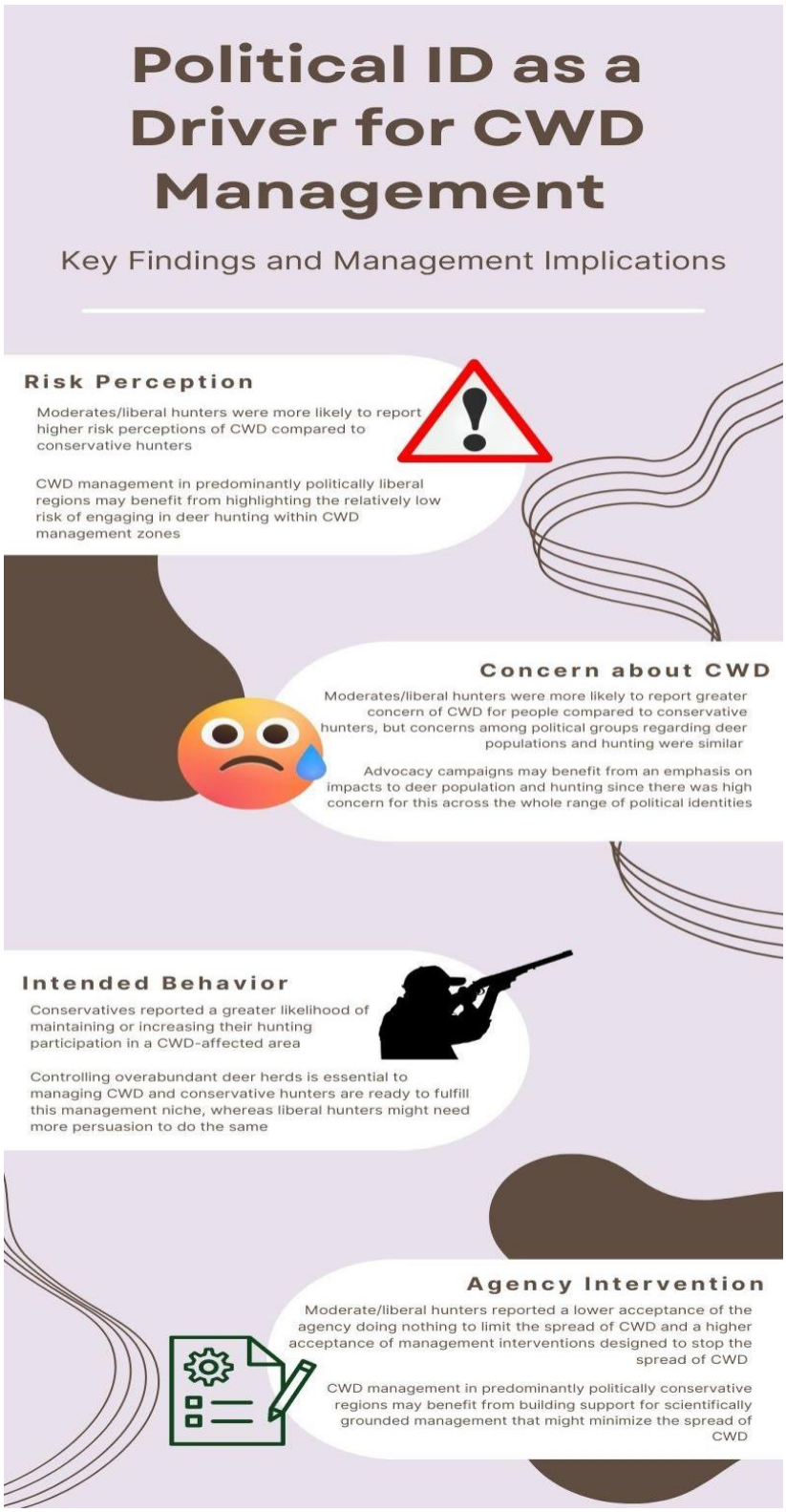
Witt, B. (2019). Tourists' willingness to pay increased entrance fees at Mexican protected areas: A multi-site contingent valuation study. *Sustainability*, *11*(11), 3041.

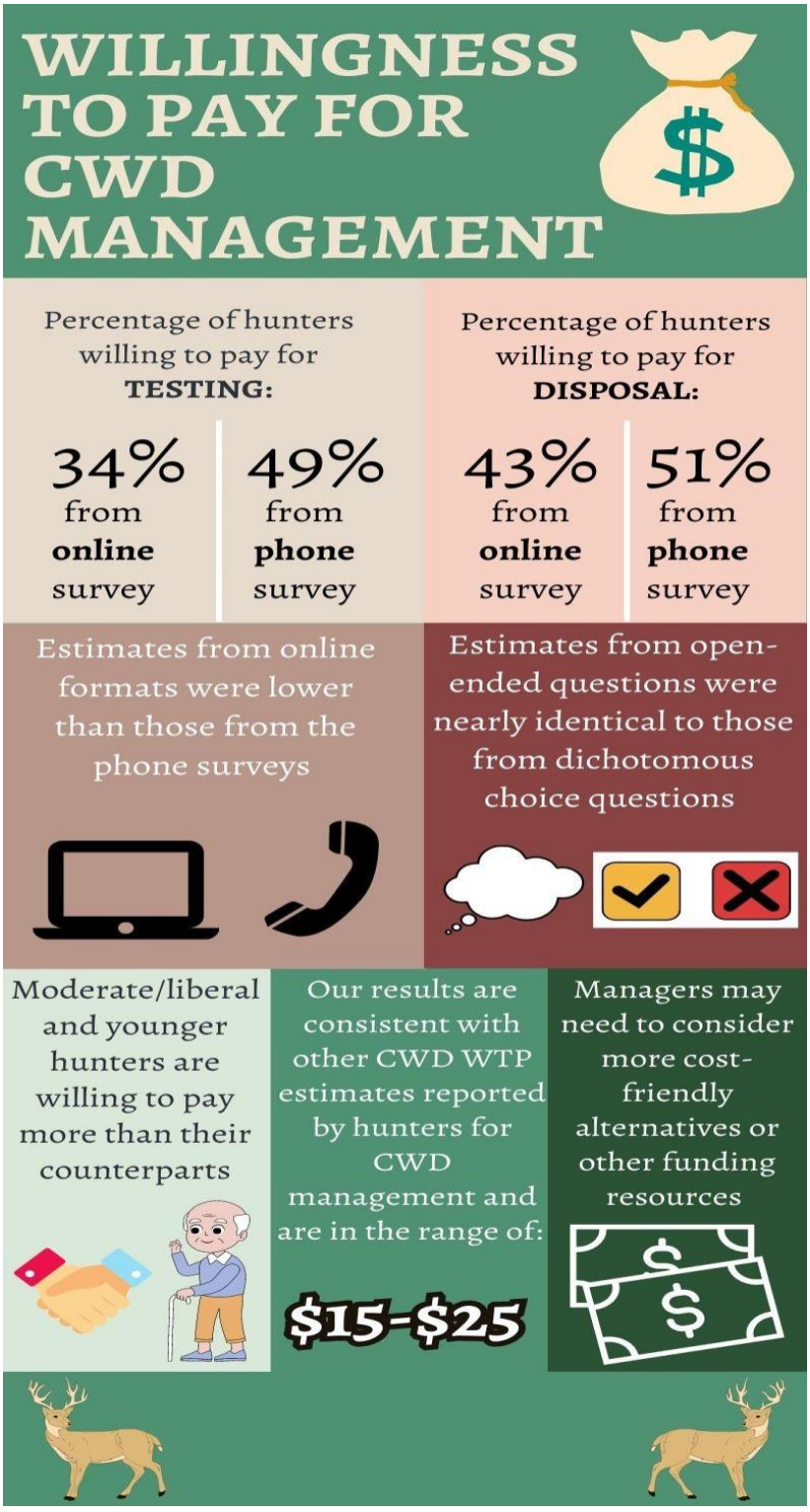
Zimmer, N. M., Boxall, P. C., & Adamowicz, W. L. (2012). The impacts of chronic wasting disease and its management on recreational hunters. *Canadian Journal of Agricultural Economics/Revue Canadienne D'agroeconomie*, *60*(1), 71-92.

CONCLUSION

In today's field of wildlife management, the OneHealth initiative has gained traction to mitigate the spread of wildlife diseases. We cannot manage these diseases without the support from key stakeholders, just like wildlife agencies cannot manage the spread of CWD without input from hunters. We hope that this study outlines ways we can more effectively integrate social science into the decision-making processes of not only CWD, but other wildlife diseases.

Below, I have outlined infographics for both chapters that summarize the key findings and management implications of my thesis. These could be shared with wildlife agencies for the purposes of CWD education and outreach.


Political ID as a Driver for CWD Management
Key Findings and Management Implications
Risk Perception
Moderates/liberal hunters were more likely to report higher risk perceptions of CWD compared to conservative hunters
CWD management in predominantly politically liberal regions may benefit from highlighting the relatively low risk of engaging in deer hunting within CWD management zones
Concern about CWD
Moderates/liberal hunters were more likely to report greater concern of CWD for people compared to conservative hunters, but concerns among political groups regarding deer populations and hunting were similar
Advocacy campaigns may benefit from an emphasis on impacts to deer population and hunting since there was high concern for this across the whole range of political identities
Intended Behavior
Conservatives reported a greater likelihood of maintaining or increasing their hunting participation in a CWD-affected area
Controlling overabundant deer herds is essential to managing CWD and conservative hunters are ready to fulfill this management niche, whereas liberal hunters might need more persuasion to do the same
Agency Intervention
Moderate/liberal hunters reported a lower acceptance of the agency doing nothing to limit the spread of CWD and a higher acceptance of management interventions designed to stop the spread of CWD
CWD management in predominantly politically conservative regions may benefit from building support for scientifically grounded management that might minimize the spread of CWD


WILLINGNESS TO PAY FOR CWD MANAGEMENT
Percentage of hunters willing to pay for TESTING:
34% from online survey
49% from phone survey
Percentage of hunters willing to pay for DISPOSAL:
43% from online survey
51% from phone survey
Estimates from online formats were lower than those from the phone surveys
Estimates from open-ended questions were nearly identical to those from dichotomous choice questions
Moderate/liberal and younger hunters are willing to pay more than their counterparts
Our results are consistent with other CWD WTP estimates reported by hunters for CWD management and are in the range of:
$15-$25
Managers may need to consider more cost-friendly alternatives or other funding resources