

# Hunter Perceptions of Risk, Social Trust, and Management of Chronic Wasting Disease in Illinois

ERIN E. HARPER,<sup>1</sup> CRAIG A. MILLER,<sup>2</sup>  
AND JERRY J. VASKE<sup>1</sup>

<sup>1</sup>Human Dimensions of Natural Resources Department, Warner College of Natural Resources, Colorado State University, Fort Collins, Colorado, USA

<sup>2</sup>Illinois Natural History Survey, Prairie Research Institute, University of Illinois, Champaign, Illinois, USA

*Management to reduce the spread of chronic wasting disease (CWD) in northern Illinois includes a controversial sharpshooting program. A mail survey of northern Illinois deer hunters was conducted (n = 3,391, response rate = 58%) to examine support or opposition toward this program, and factors contributing to these reactions. Logistic regression revealed that support for sharpshooting was statistically greater when: (a) respondents trusted the agency's (Illinois Department of Natural Resources) management of CWD, and (b) perceived risks of CWD to both personal health and deer health increased. Support for sharpshooting was less when hunters trusted CWD information provided by the agency. This regression model predicted 72% of hunter opposition to the program and 74% of support. Log-linear analysis showed that trust and risk interacted in their effects on support or opposition toward sharpshooting. Findings supported past research examining social trust and risk perceptions in predicting other cognitions associated with CWD.*

**Keywords** CWD, sharpshooting, trust, risk, perceptions, Illinois

## Introduction

Chronic wasting disease (CWD) is a transmissible spongiform encephalopathy (TSE) in deer, elk, and moose that is similar to bovine spongiform encephalopathy in cattle (BSE, mad cow disease) and scrapie in sheep. Caused by a prion protein mutation, CWD results in loss of coordination, emaciation, and death in all affected animals (Williams, Miller, Kreeger, Kahn, & Thorne, 2002). Although the exact means of transmission are unknown, two hypotheses have been suggested: (a) risk of contraction increases with animal density, suggesting direct transmission (Joly et al., 2006) and (b) prion persistence in the environment may increase infection, suggesting that transmission is not solely dependent on direct contact (Miller, Hobbs, & Tavener, 2006). There is no current evidence suggesting that CWD poses a direct risk to human health, but transmission to humans cannot be completely dismissed (Belay et al., 2004; Raymond et al., 2000). To date, 20 states in the United States and two Canadian provinces have reported positive cases of CWD in free ranging cervids

Address correspondence to Erin E. Harper, Human Dimensions of Natural Resources Department, Warner College of Natural Resources, Colorado State University, Fort Collins, Colorado, USA. E-mail: [eeharper@gmail.com](mailto:eeharper@gmail.com)

(Centers for Disease Control, 2013; Chronic Wasting Disease Alliance, 2014). Wildlife agencies are the first line of investigation and management of CWD, and serve as the main sources for current information about this disease.

CWD was found in free ranging white-tailed deer (*Odocoileus virginianus*) in northern Illinois during November 2002 (Illinois Department of Natural Resources [IDNR], 2013). As of January 2014, the disease had spread to 13 counties with 409 positive cases. CWD is a concern because of the importance of hunting to local economies, sales of hunting licenses, and overall health of deer populations (Needham, Vaske, & Manfredro, 2004, 2006). Given that the relatively high deer densities in northern Illinois may increase the probability of CWD transmission, the IDNR has implemented several management efforts, including sharpshooting, to help curtail the spread of this disease (IDNR, 2013). This sharpshooting program involves trained IDNR personnel culling deer in high human population areas within CWD counties that are not accessible to hunting (e.g., residential areas, certain public lands). Research has suggested that CWD prevalence increases in non-hunted deer populations (e.g., Wasserberg, Osnas, Rolley, & Samuel, 2008). The use of sharpshooting has been controversial among hunters in CWD counties (Jenkins, 2012). Hunters in public meetings blamed the IDNR for decreased deer numbers and cited a breach of trust with this agency (Hart, 2012). This article predicts hunter support or opposition toward sharpshooting based on their perceptions of risk and agency trust.

## Literature Review

Managing animal herds to limit the spread of CWD has evolved as the disease has been discovered in more states, management plans have been altered or abandoned, and political and social issues have factored into management. Given that CWD can potentially spread by direct animal contact, reducing deer populations has been a primary management strategy (Cooney & Holsman, 2010). For some hunters, however, culling deer to prevent the disease from killing deer seems paradoxical (Holsman, Petchenik, & Cooney, 2010).

In a comparative analysis of 12 separate surveys of Wisconsin hunters, six domains were identified that explain opposition toward agency plans to eliminate CWD: population goals, norms for meat consumption, deer hunting traditions, perception that the disease threat lacked urgency, low risk perceptions, and lack of agency credibility (Holsman et al., 2010). These domains have stimulated hunter opposition to the use of sharpshooting (Wisconsin Outdoor News, 2010).

To understand this opposition, research has sought to predict hunter responses to CWD and its management (e.g., Gigliotti, 2004; Miller, 2003, 2004; Needham et al., 2004, 2006; Petchenik, 2003), but results have been somewhat mixed. For example, in a survey of northern Illinois hunters conducted less than a year following the 2002 outbreak of CWD in this state, 83% of respondents reported that CWD did not influence their hunting behaviors (Miller, 2003). On the other hand, hunting license sales declined significantly in both South Dakota and Wisconsin the year following discovery of CWD in each state (Gigliotti, 2004; Heberlein, 2004). Human health-related concerns associated with CWD attributed to about half of the observed decline in Wisconsin (Vaske, Timmons, Beaman, & Petchenik, 2004). In an eight-state regional study, Needham et al. (2004, 2006) found that 49% of hunters would stop participating if a majority of deer or elk were infected with CWD. Prevalence of CWD and human health risks were significant predictors of hunting participation (Lyon & Vaske, 2010; Vaske & Lyon, 2011), and perceived risk may prompt hunters to reduce or stop participating and favor some management actions over others (Miller & Shelby, 2009; Needham & Vaske, 2006).

### ***Perceived Risk***

Perceived risk is the degree to which individuals believe they are threatened by some hazard or danger (Siegrist & Cvetkovich, 2000; Sjöberg, 2000). Perceptions of risk are subjective and can influence decision-making and behavior under uncertainty (Fischhoff, Slovic, Lichtenstein, Read, & Combs, 1978; Siegrist, Gutscher, & Earle, 2005; Slovic, 1987). Stakeholder risk perceptions can influence their support for management actions, including lethal control (Cooney & Holsman, 2010). Needham et al. (2004, 2006), for example, found that hunter acceptance of lethal control by the agency was neutral if CWD prevalence was low or moderate, but acceptance increased as prevalence and/or possible risks to human health increased.

Among Illinois hunters, 54% were uncertain about CWD and human health, 20% believed the disease posed a risk to deer but not to humans, and 17% felt that humans could potentially contract CWD if they ate meat from an infected animal (Miller, 2004). Only 10% of these hunters believed the threat from CWD was exaggerated. In the eight state regional study, 33% of hunters believed the threat from CWD had been exaggerated, 32% thought the risk was isolated to deer and elk but not humans, and 44% believed there was a possible risk to humans (Needham & Vaske, 2006).

Miller and Shelby (2009) compared perceived risks from CWD, BSE (i.e., mad cow), *Salmonella*, *E.coli*, West Nile Virus, and Lyme disease. Three hunter segments were identified (no, slight, moderate risk). The moderate risk group reported the lowest hunting participation, was most likely to change hunting behavior due to CWD (42%), and believed that CWD was a risk to humans (81%). Using both a risk index and a social trust index, Vaske et al. (2004) were able to correctly predict 83% of hunters who would stop hunting due to CWD. Those hunters who did not hunt because of CWD were 16 times more likely to not hunt due to perceived risks associated with CWD. Needham and Vaske (2008) found a negative relationship between trust and risk; those who perceived more personal risk from CWD were less likely to trust the agencies responsible for managing this disease.

### ***Social Trust***

Social trust is the willingness to rely on those who have the responsibility for making decisions and taking actions related to the management of hazards (Siegrist & Cvetkovich, 2000). The adjective “social” emphasizes that the people being trusted are those with formal responsibilities within organizations that may or may not be personally known to the person making the trust attribution (Siegrist, Cvetkovich, & Roth, 2000). Trust can play a role in influencing risk perceptions (Cvetkovich & Winter, 2003; Siegrist & Cvetkovich, 2000; Sjöberg, 2001), especially in the absence of knowledge about a hazard (Siegrist et al., 2005). Hunter knowledge about CWD is generally low. Prior to the discovery of CWD in Wisconsin, for example, few people had even heard of the disease (Heberlein & Stedman, 2009). In response to a series of true/false questions, fewer than 5% of Wisconsin hunters answered all CWD questions correctly and the largest proportion failed to answer more than half correctly (Vaske, Needham, Stafford, Green, & Petchenik, 2006).

Wisconsin hunters who did not hunt for reasons associated with CWD were less trusting of information provided by the Wisconsin Department of Natural Resources (WDNR) than hunters who either dropped out for other reasons or were among those who continued to hunt (Vaske et al., 2004). In addition to participation, trust in managing agencies has also been suggested as an important psychological predictor of support for specific management

actions (Needham & Vaske, 2008). Vaske, Absher, and Bright (2007), for example, concluded that as trust increased, support for fire management strategies increased. A study of Wisconsin deer hunters (Holsman et al., 2010) proposed that the WDNR had low levels of credibility among Wisconsin hunters regarding deer management that was not directly related to CWD, and these pre-existing attitudes transferred to CWD management and created low trust for CWD programs.

### **Hypotheses**

This article examined the influence of perceived risk and social trust on hunter support or opposition toward sharpshooting as a management tool for controlling CWD in Illinois. The following hypotheses were advanced:

H1: Perceived risk will be positively related to support for using sharpshooting to manage CWD.

H1a: Perceived risk of CWD to *personal health* will be positively related to support for using sharpshooting to manage CWD.

H1b: Perceived risk of CWD to *deer herd health* will be positively related to support for using sharpshooting to manage CWD.

H2: Social trust will be positively related to support for using sharpshooting to manage CWD.

H2a: Social trust in CWD *information* will be positively related to support for using sharpshooting to manage CWD.

H2b: Social trust in overall CWD *management* will be positively related to support for using sharpshooting to manage CWD.

H3: Interactions among the predictors (perceived risk, social trust) will be related to support for using sharpshooting to manage CWD.

### **Methods**

Data were obtained from a mail survey of 6,000 deer hunters sampled randomly from all 2011 resident deer permit holders in northern Illinois. Hunters were stratified by residence in one of 10 counties where CWD was found (at the time of the survey,  $N = 3,000$ ), or in counties adjacent to a CWD county ( $N = 3,000$ ). Three mailings were used for administering questionnaires beginning in July 2012 and ending in November 2012. Residents first received the questionnaire, a pre-paid postage return envelope, and a personalized cover letter explaining the study and requesting participation. Two weeks after this initial mailing, a reminder postcard was sent to participants. A second complete mailing (questionnaire, return envelope, letter) was sent to non-respondents 10 days after this postcard reminder. To further increase the response rate, a third complete mailing was sent one month following the second complete mailing. A total of 3,391 (response rate = 58%) completed questionnaires were received. A nonresponse bias survey was not completed due to budgetary constraints (Miller, McCleary, Harper, & Campbell, 2013).

### ***Dependent Variable***

Participants were asked to choose between two statements: (a) “I favor ending IDNR sharpshooting with a higher likelihood of CWD spreading to more counties” or (b) “I favor continuing IDNR sharpshooting to reduce the likelihood of CWD spreading to more counties” with responses coded as 0 (oppose sharpshooting) and 1 (support sharpshooting), respectively. These statements infer a cause and effect relationship that reflects both current research and IDNR management and intentions. Research in both Illinois and Wisconsin (Mateus-Pinilla, Weng, Ruiz, Shelton, & Novakofski, 2013) demonstrated that the intervention of sharpshooting can minimize the spread of CWD. When Wisconsin stopped culling in 2007, the prevalence of CWD increased (Manjerovic, Green, Mateus-Pinilla, & Novakofski, 2014). Illinois continued culling and there was only a slight increase in the prevalence of this disease. Although these two interventions (i.e., sharpshooting vs. no sharpshooting) might lead to consequences other than controlling or increasing the spread of CWD, the IDNR was most interested in these two scenarios being measured in this study.

### ***Independent Variables***

Personal health risk regarding CWD was measured with five questions. One question asked, “because of CWD, how concerned are you about your own personal health” (scale: 1 & 2 = *not at all concerned*, 3 & 4 = *slightly concerned*, 5 & 6 = *moderately concerned*, 7 & 8 = *extremely concerned*). A second question asked “how much risk do you feel from . . . becoming ill from CWD” (scale: 1 = *no risk* to 4 = *high risk*). Three additional statements were measured on 7-point scales (1 = *strongly disagree*, 7 = *strongly agree*): (a) “CWD may cause disease in humans if they eat meat from animals infected by CWD,” (b) “because of CWD my family has concerns about eating deer meat,” and (c) “because of CWD I have concerns about eating deer meat.” Given these items were measured on different scales, they were converted to standardized *z*-scores prior to additional analysis.

Perceived risk to deer health was measured with five items—“because of CWD, how concerned are you about . . . (a) the health of the deer population in Illinois, (b) not having enough healthy deer left to hunt in Illinois, (c) CWD spreading throughout the entire deer population in Illinois, (d) the potential for CWD to dramatically reduce the deer population in Illinois, and (e) the potential for CWD to kill the entire deer population in Illinois.” Each item was measured on 8-point scales from 1 = *not at all concerned* to 8 = *extremely concerned*.

Trust was examined for both IDNR management and information. The management questions asked: “I trust the IDNR to: (a) make good deer management decisions regarding CWD issues, (b) follow the best available science in managing CWD, and (c) properly address CWD in Illinois.” The information questions asked: “I trust the IDNR to provide truthful information: (a) about human safety issues related to CWD, (b) about how CWD spreads, and (c) on the number of CWD-positive deer discovered in Illinois.” Each statement was measured on 7-point scales (1 = *strongly disagree*, 7 = *strongly agree*) and recoded to  $-3$  to  $+3$  for purposes of analysis.

### ***Data Analysis***

Cronbach’s alpha was used for examining the reliability of each set of independent variables measuring risks to personal and deer health, and trust in agency management and information. A binary logistic regression was used for determining the effect of each of these independent variables on support or opposition toward using sharpshooting to manage

CWD. Backward stepwise hierarchical log-linear analysis was used for modeling multivariate relationships among the variables. In log-linear models, all variables are considered as independent. The null hypothesis was that each variable was independent of one another and that no associations existed. Partial log likelihood chi-squares were used for testing variable associations among the five variables in the model: risk to humans (personal health), risk to deer, trust in management, trust in information, support/opposition toward sharpshooting.

## Results

Reliability analysis for perceived personal risk yielded a Cronbach's alpha of .83 (Table 1). On average, hunters perceived no risk of becoming ill from CWD ( $M = 1.64$ , on a scale of 1 = *no risk* to 4 = *high risk*), but perceived slight risks toward their own personal

**Table 1**  
Perceived risk from CWD to personal health and deer herd health among Illinois deer hunters

Perceived risk variables	Mean	Cronbach's alpha of item deleted	Cronbach's alpha
Personal risk			.83
Because of CWD, how concerned are you about your own personal health <sup>1</sup>	3.54	.79	
How much risk do you feel from becoming ill from CWD <sup>2</sup>	1.64	.82	
CWD may cause disease in humans if they eat meat from animals infected with CWD <sup>3</sup>	3.65	.81	
Because of CWD:			
my family has concerns about eating deer meat <sup>3</sup>	3.16	.80	
I have concerns about eating deer meat <sup>3</sup>	3.15	.77	
Risk to the deer herd			.92
Because of CWD, how concerned are you about:			
the health of the deer population in Illinois <sup>1</sup>	5.49	.92	
not having enough healthy deer left to hunt in Illinois <sup>1</sup>	5.42	.91	
CWD spreading throughout the entire deer population in Illinois <sup>1</sup>	5.26	.89	
the potential for CWD to dramatically reduce the deer population in Illinois <sup>1</sup>	5.17	.89	
the potential for CWD to kill the entire deer population in Illinois <sup>1</sup>	4.57	.91	

<sup>1</sup>Measured on an 8-point scale (1 = *not at all concerned*, 8 = *extremely concerned*).

<sup>2</sup>Measured on a 4-point scale (1 = *no risk*, 4 = *high risk*).

<sup>3</sup>Measured on a 7-point scale (1 = *strongly disagree*, 7 = *strongly agree*).

health ( $M = 3.54$ , on a scale of 1 = *not at all concerned* to 8 = *extremely concerned*), from eating meat of infected animals ( $M = 3.65$ , on a scale of 1 = *not at all concerned* to 8 = *extremely concerned*), with their family eating deer meat ( $M = 3.16$ , on a scale of 1 = *strongly disagree* to 7 = *strongly agree*), or with themselves eating deer meat ( $M = 3.15$ , on a scale of 1 = *strongly disagree* to 7 = *strongly agree*). Hunters perceived moderate risks to deer health ( $M = 5.49$ ), having healthy deer to hunt ( $M = 5.42$ ), CWD spreading ( $M = 5.26$ ), CWD reducing the herd ( $M = 5.17$ ), and CWD killing the entire herd ( $M = 4.57$ ), all on a scale of 1 = *not at all concerned* to 8 = *extremely concerned*. The Cronbach's alpha for this index was .92.

Trust in IDNR management had an alpha of .93 (Table 2). On average, hunters slightly trusted the IDNR to make good deer management decisions regarding CWD ( $M = .75$ ), follow the best available science in managing this disease ( $M = 1.05$ ), and properly address CWD in Illinois ( $M = .96$ , all on a scale of  $-3 = \textit{strongly disagree}$  to  $3 = \textit{strongly agree}$ ). The alpha for trusting IDNR information was .94. Hunters slightly trusted information the IDNR provides regarding available information on CWD in Illinois ( $M = 1.10$ ), how timely

**Table 2**  
Perceived trust in agency information and management of CWD among Illinois deer hunters

Perceived trust variables	Mean	Cronbach's alpha if item deleted	Cronbach's alpha
Trust in IDNR management <sup>1</sup>			.93
I trust IDNR to:			
make good deer management decisions regarding CWD issues	.75	.93	
follow the best available science in managing CWD	1.05	.90	
properly address CWD in Illinois	.96	.87	
Trust in IDNR information <sup>1</sup>			.94
I trust IDNR to provide:			
the best available information on CWD in Illinois	1.10	.94	
timely information regarding CWD issues	0.95	.93	
I trust IDNR to provide truthful information:			
about human safety issues related to CWD	1.17	.92	
about how CWD spreads	1.26	.92	
on the number of CWD-positive deer discovered in Illinois	1.37	.93	

<sup>1</sup>Responses given on 7-point recoded scale:  $-3 = \textit{strongly disagree}$ ,  $-2 = \textit{disagree}$ ,  $-1 = \textit{slightly disagree}$ ,  $0 = \textit{unsure}$ ,  $1 = \textit{slightly agree}$ ,  $2 = \textit{agree}$ ,  $3 = \textit{strongly agree}$  (originally measured on a 1–7 scale).

the information is relayed ( $M = .95$ ), human safety related to CWD ( $M = 1.17$ ), how CWD spreads ( $M = 1.26$ ), and the number of positive CWD cases in Illinois ( $M = 1.37$ , all on a scale of  $-3 = \textit{strongly disagree}$  to  $3 = \textit{strongly agree}$ ). Given the high internal consistency of these variables measuring risk and trust, they were combined into four composite indices measuring these cognitions (i.e., risk to deer, risk to humans, trust in management, trust in information).

A majority (52%) of respondents chose “I favor ending IDNR sharpshooting with a higher likelihood of CWD spreading to more counties” (i.e., oppose sharpshooting) over “I favor continuing IDNR sharpshooting to reduce the likelihood of CWD spreading to more counties” (support sharpshooting; 48%). The logistic regression model indicated that all four composite indices representing the independent variables were significant predictors of this support/opposition ( $p < .001$ , Nagelkerke  $R^2 = .35$ , Table 3). The best predictor was trust in IDNR management; individuals who were more trusting of this agency’s overall CWD management approach were more likely to support the specific strategy of sharpshooting (Odds Ratio [OR] = 2.55). This finding supports Hypothesis 2b. Conversely, the relationship between trust in IDNR information and support for sharpshooting was negative ( $OR = .58$ ). This finding suggests that hunters who were more trusting of IDNR information were less likely to support sharpshooting; findings that contradict Hypothesis 2a. The remaining two predictors were statistically significant and in the predicted direction. Hunters were more likely to support sharpshooting if they: (a) perceived greater risks to personal health ( $OR = 1.83$ ), and (b) believed the health of the deer herd was at greater risk from CWD ( $OR = 1.22$ ). These findings support Hypotheses 1a and 1b, respectively. Overall, this regression model correctly classified 72% of the cases that opposed sharpshooting, and 74% of those who supported sharpshooting (Table 4).

The third hypothesis predicted that the four composite indices representing the independent variables would interact to influence support/opposition toward sharpshooting. The multivariate log-linear analysis identified nine significant 2-way interactions and one significant 4-way interaction (Table 5); the 3-way and 5-way interactions were not significant. The 2-way associations indicated that trust in management significantly interacted with the other four variables, trust in information interacted with both risk variables, and the risk variables had interaction effects on one another as well as support/opposition toward sharpshooting. The significant 4-way interaction, support \* risk to deer \* trust information \* trust in management, indicated that participants who perceived greater risk to deer and have more trust in the information and management decisions provided by the agency were more likely to support sharpshooting.

**Table 3**

Logistic regression model of risk and trust variables for support for sharpshooting among Illinois deer hunters (Nagelkerke  $R^2 = .35$ )

Independent variable	Wald	Odds Ratio	<i>p</i>
Trust in IDNR management of CWD	167.05	2.55	<.001
Trust in IDNR information on CWD	54.11	.58	<.001
Perceived risk to personal health from CWD	81.86	1.83	<.001
Perceived risk to deer herd health from CWD	61.77	1.22	<.001



**Table 4**

Classification table for logistic regression predicting support for sharpshooting among Illinois deer hunters

Observed	Predicted		Percent correctly classified
	Oppose sharpshooting ( <i>n</i> )	Support sharpshooting ( <i>n</i> )	
Oppose sharpshooting	1,185	465	72
Support sharpshooting	389	1,112	74
Overall %			73

**Table 5**

Hierarchical log-linear model for 2- and 4-way interactions

Significant interactions <sup>a</sup>	<i>df</i>	Partial $\chi^2$	<i>p</i>
4-way interaction			
Support*Risk to Humans*Trust Information*Trust Management	1	4.87	.027
2-way interaction			
Support*Risk to Humans	1	100.71	<.001
Support*Risk to Deer	1	108.22	<.001
Risk to Humans*Risk to Deer	1	261.81	<.001
Risk to Humans*Trust Information	1	1.19	<.001
Risk to Deer*Trust Information	1	14.77	<.001
Support*Trust Management	1	141.94	<.001
Risk to Humans*Trust Management	1	26.93	<.001
Risk to Deer*Trust Management	1	29.96	<.001
Trust Information*Trust Management	1	1282.72	<.001
Test that K-way effects are zero			
Support	1	7.95	.005
Risk to Humans	1	6.42	.011
Risk to Deer	1	20.25	<.001
Trust Information	1	112.28	<.001
Trust Management	1	137.22	<.001

<sup>a</sup>Only significant ( $p < .05$ ) effects are shown. Risk to humans is the same as personal health risk.

## Discussion

This article examined the influence of perceived risk and social trust on support or opposition toward using sharpshooting as a tool for managing the spread of CWD in Illinois. Perceived risk was operationalized as risk to personal health and risk to deer health. Social trust was conceptualized as trust in the IDNR's CWD management and information. Both risk and trust were significant predictors of hunter support or opposition toward

sharpshooting, and three of the four hypotheses were supported. Higher perceived risk to personal health (Hypothesis 1a) and deer health (Hypothesis 1b) were associated with increased support for sharpshooting. Similarly, greater trust in IDNR management correlated with higher support for sharpshooting (Hypothesis 2b). Contrary to Hypothesis 2a, trust in CWD information was not positively related to sharpshooting. Interactions among these variables were hypothesized to influence support for sharpshooting and multivariate analysis confirmed that support interacted with all four predictors. These findings have implications for both management and theory.

Using sharpshooting to manage CWD is controversial (Cooney & Holsman, 2010; Jenkins, 2012; Smith, 2013) and findings here reflect the extent of this controversy; hunters were about evenly divided in their support (48%) versus opposition (52%) to sharpshooting. Articles in the popular press suggest that hunters, rather than just sharpshooters, should have the opportunity to help control the spread of the disease (e.g., Hart, 2012). Past research (Needham et al., 2004; Needham & Vaske, 2006) examined support for this approach. In the case of Illinois, for example, hunters support management of CWD, but believe that they should also be one of the first lines of defense against the disease (Miller et al., 2013).

This article examined a management action (use of sharpshooting to reduce deer populations) given two possible consequences (i.e., CWD spreading to other locations vs. controlling the spread of the disease). This management action and plausible consequences have been supported by past research (Manjerovic et al., 2014; Mateus et al., 2013) and the IDNR was most interested in these two outcomes. Alternative actions (e.g., use of hunters and increase, keep the same, decrease, or eliminate sharpshooting) and consequences (e.g., increase, no change, or decrease in CWD prevalence) either by themselves or in combination might be of interest in other states and should be examined in future work.

Responses to sharpshooting were partially related to hunter trust in agency (IDNR) management and perceived risks associated with CWD. Illinois hunters expressed slight trust in the agency to manage this disease, provide the best information on CWD in a timely manner, and to be truthful about human safety, how CWD spreads, and the number of CWD-positive deer. These slight levels of trust might be attributed to a variety of sources.

Hunters have complained in public meetings about not seeing as many deer as in previous years and have blamed the sharpshooting program for such reductions (Jenkins, 2012). Ancillary analyses of other variables in this study suggest that Illinois hunters believed that the deer population has declined (Miller et al., 2013). During 2012, sharpshooters killed 1,475 deer in the 10 counties known to have the disease, and nearly 11,000 since control efforts began in 2003 (Hart, 2012). Other contributing factors for the decline, however, may include higher harvest limits, longer seasons (e.g., unlimited antlerless deer hunting during the 108-day archery season), special CWD hunting seasons, and the disease itself (Williams et al., 2002). Further research is warranted to understand the magnitude of each of these potential causes.

General trust in agency management has been shown to transfer to cognitions about specific management practices (Holsman et al., 2010; Needham & Vaske, 2008; Vaske et al., 2004). Illinois hunters who trusted the IDNR with respect to its management were more than twice as likely to support continuation of the sharpshooting program. Findings for trust in IDNR information, however, revealed a different pattern where hunters who trusted this agency's information were less likely to support sharpshooting. There are several possible explanations for this difference. For example, more than a decade has passed since discovery of CWD in Illinois, providing hunters an opportunity to review the material published by the IDNR, discuss this information with others, and reach their own

conclusions about the validity of information. On average, hunters “slightly agreed” with each of the information statements in this study. Agreeing with the information provided, however, does not imply that the hunters agree with management actions. With a greater understanding of CWD, hunters may also perceive that this disease lacks the urgency associated with sharpshooting (Holsman et al., 2010). More research is necessary to understand the relationship between agreement with specific information and support for management actions.

Trust has been shown to influence hunter risk perceptions regarding CWD (Needham & Vaske, 2008; Vaske et al., 2004). Such perceptions are influenced by the “newness” of the threat. Similar to findings from Wisconsin (Holsman et al., 2010), Illinois hunters initially perceived moderate levels of risk to human health. In both states, however, empirical evidence suggests that these risks have diminished since the initial discovery of CWD. For example, 12% of Wisconsin hunters reported a “personal concern over venison safety” in 2003; that number dropped to 4% in 2004 (Holsman, 2005). Whether such responses would be found in states where CWD has been commonplace for many years (e.g., Colorado, Wyoming) remains a question for future research.

Data presented in this article show slight perceived risk to personal health and moderate perceived risks to deer health. Most agency information and education campaigns state that there is no evidence that CWD poses a human health risk (Eschenfelder, 2006). These same messages, however, also advise hunters to take precautions such as testing animals for CWD and wearing gloves when processing animals, implying that a risk may be present. Although agencies are likely to continue communicating precautionary messages primarily out of concern for liability and public safety, this ambiguity in the messages may amplify perceptions of risk (Needham & Vaske, 2006, 2008). Hunters may believe that mixed messages suggest that wildlife agencies are uncertain about CWD, which may influence trust and risk evaluations (Needham & Vaske, 2008; Vaske & Lyon, 2011). Concerns about CWD could also stem from its similarity to related diseases that can cause human death (e.g., mad cow, Creutzfeldt-Jakob; Miller et al., 2006). Miller and Shelby (2009), for example, found that hunters perceived the risk of becoming ill from CWD and mad cow disease as similar. Wildlife agencies should take these issues into consideration when developing CWD communication campaigns and planning their response to this disease (Vaske, 2010).

Findings here underscore several additional implications. First, consistent with other studies, results showed that risk perceptions and trust in managing agencies can influence support or opposition toward management (Vaske, 2010; Vaske et al., 2007). The relationship between perceived risk and social trust, however, is less clear. This study showed that trust and risk interacted in their effects on support or opposition toward sharpshooting. Needham and Vaske (2008) showed relatively weak but consistently negative relationships between trust in wildlife agencies and perceived risk associated with CWD. Similarly, Winter, Vogt, and McCaffrey (2004) found only weak to moderate relationships between perceptions of agency trust and risk related to wildfire management approaches. Given that most of the variance in risk remains unexplained by trust, other risk attributes such as knowledge, control, dread, and newness may contribute to perceptions of CWD risk (e.g., Fischhoff et al., 1978; Sjöberg, 2000). There may also be other dimensions of trust that were not measured (e.g., honesty, competence).

Research on other topics (e.g., nuclear power), however, has shown much stronger relationships between trust and risk (Flynn, Slovic, & Mertz, 1994; Siegrist et al., 2000). Nuclear power, however, is created and controlled by humans, whereas CWD occurs naturally and has spread to new locations (Miller et al., 2006). Natural risks are often considered more uncontrollable and random (i.e., higher risk) than anthropogenic risks (e.g., Sjöberg,

2000). Hunters may trust wildlife agencies to manage CWD (as shown in this study), but believe that they have limited knowledge about the disease and feel that potential risks associated with CWD are beyond agency control or do not pose a substantial threat. To mitigate CWD associated risk perceptions, agencies may need to better inform hunters about strategies for managing the disease (e.g., CWD testing).

Many studies investigating relationships between trust and perceived risks have focused on agencies responsible for managing a hazard. This scope, however, could be broadened. Risk perceptions can also be influenced by other sources such as interest groups, media, friends, and family. This may partially explain the mixed results in studies examining relationships between trust and risk (Needham & Vaske, 2008; Siegrist et al., 2000; Viklund, 2003; Walls, Pidgeon, Weyman, & Horlick-Jones, 2004). Effects of other diverse information sources on judgments of risk related to CWD and other natural resource issues warrant research attention.

The concepts of trust and risk have generated considerable interest in the broader social science literature. Given the contentious nature of natural resource management issues such as CWD, continuing to draw on the trust and risk literature may facilitate a better understanding of challenges faced by resource managers. Scientists are encouraged to address research needs identified here and improve understanding of the human dimensions of CWD and other diseases.

### Acknowledgments

We thank the many individuals who played important roles throughout this research. Our thanks go to Mark G. Alessi for his vital contributions to the development and administration of the research instruments, Paul Shelton and Tom Micetich for their suggestions and insights, Linda Campbell for her patience and dedication, and to the numerous student employees of the INHS Human Dimensions Research Program.

### Funding

This project was funded by Federal Aid in Wildlife Restoration grant W-112-R-22.

### References

- 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. *Journal of Health Economics*, 21, 993–1007.
- Centers for Disease Control. (2013, November). *Chronic wasting disease among free-ranging cervids by county, United States*. Retrieved from [http://www.cdc.gov/ncidod/dvrd/cwd/geographic\\_range.htm](http://www.cdc.gov/ncidod/dvrd/cwd/geographic_range.htm)
- Chronic Wasting Disease Alliance. (2014). Graph illustration of Chronic Wasting Disease in North America October 2014. *Learn about CWD: Map*. Retrieved from <http://www.cwd-info.org/index.php/fuseaction/about.map>
- Cooney, E. E., & Holsman, R. H. (2010). Influences on hunter support for deer herd reduction as a chronic wasting disease (CWD) management strategy. *Human Dimensions of Wildlife*, 15, 194–207.
- Cvetkovich, G. T., & Winter, P. L. (2003). Trust and social representations of the management of threatened and endangered species. *Environment and Behavior*, 35, 286–307.

- Eschenfelder, K. (2006). What information should state wildlife agencies provide on their CWD websites? *Human Dimensions of Wildlife*, 11, 221–223.
- Fischhoff, B., Slovic, P., Lichtenstein, S., Read, S., & Combs, B. (1978). How safe is safe enough? A psychometric study of attitudes towards technological risks and benefits. *Policy Sciences* 8, 127–152.
- Flynn, J., Slovic, P., & Mertz, C. K. (1994). Gender, race, and perception of environmental health risks. *Risk Analysis*, 14, 1101–1108.
- Gigliotti, L. M. (2004). Hunters' concerns about chronic wasting disease in South Dakota. *Human Dimensions of Wildlife*, 9, 233–235.
- Hart, D. (2012). *CWD control efforts divide hunters*, DNR. Peoria, IL: Petersen's Hunting. <http://www.petersenshunting.com/2012/06/25/cwd-control-efforts-divide-hunters-dnr/>
- Heberlein, T. A. (2004). "Fire in the Sistine Chapel": How Wisconsin responded to chronic wasting disease. *Human Dimensions of Wildlife*, 9, 165–179.
- Heberlein, T. A., & Stedman R. C. (2009). Socially amplified risk: Attitude and behavior change in response to CWD in Wisconsin deer. *Human Dimensions of Wildlife*, 14, 326–340.
- Holsman, R. H. (2005). *Untangling the relationship between effort and hunter harvest: Results from 2004 (year 2) study of deer hunters in Wisconsin's chronic wasting disease eradication zone*. Stevens Point, WI: College of Natural Resources, UW-Stevens Point.
- Holsman, R. H., Petchenik, J., & Cooney, E. E. (2010). CWD After "the fire": Six reasons why hunters resisted Wisconsin's eradication effort. *Human Dimensions of Wildlife*, 15, 180–193.
- Illinois Department of Natural Resources. (2013). *Illinois chronic wasting disease: 2012–2013 surveillance and management report*. Springfield, IL: Forest Wildlife Program.
- Jenkins, M. (2012, March 22). Sharpshooting program causes friction in northern Illinois. *Illinois Outdoor News*, p. 1.
- Joly, D. O., Samuel, M. D., Langenberg, J. A., Blanchong, J. A., Batha, C. A., Rolley, R. E., . . . Ribic, C. A. (2006). Spatial epidemiology of chronic wasting disease in Wisconsin white-tailed deer. *Journal of Wildlife Diseases*, 42, 578–588.
- Lyon, K. M., & Vaske, J. J. (2010). Predicting hunting participation in response to chronic wasting disease in four states. *Human Dimensions of Wildlife*, 15, 208–220.
- Manjerovic, M. B., Green, M. L., Mateus-Pinilla, N., & Novakofski, J. (2014). The importance of localized culling in stabilizing chronic wasting disease prevalence in white-tailed deer populations. *Preventive Veterinary Medicine*, 113, 139–145.
- Mateus-Pinilla, N., Weng, H.-Y. Ruiz, M. O., Shelton, P., & Novakofski, J. (2013). Evaluation of a wild white-tailed deer population management program for controlling chronic wasting disease in Illinois, 2003–2008. *Preventive Veterinary Medicine*, 110, 541–548.
- Miller, C. A. (2003). Hunter perceptions and behaviors related to chronic wasting disease in Northern Illinois. *Human Dimensions of Wildlife*, 8, 229–230.
- Miller, C. A. (2004). Deer hunter participation and chronic wasting disease in Illinois: An assessment at time zero. *Human Dimensions of Wildlife*, 9, 237–238.
- Miller, C. A., & Shelby, L. A. (2009). Hunters' general disease risk sensitivity and behaviors associated with chronic wasting disease. *Human Dimensions of Wildlife*, 14, 133–141.
- Miller, C. A., McCleary, M. E., Harper, E. E., & Campbell, L. K. (2013). *Stakeholder attitudes toward deer management and chronic wasting disease in Illinois*. (Job Completion Report, Federal Aid in Wildlife Restoration W-112-R-21 & 22. Human Dimensions Research Program Report HR-11-05/INHS Technical Report 32). Champaign, IL: Natural History Survey.
- Miller, M. W., Hobbs, N. T., & Tavener, S. J. (2006). Dynamics of prion disease transmission in mule deer. *Ecological Applications*, 16, 2208–2214.
- Needham, M. D., & Vaske, J. J. (2006). Beliefs about chronic wasting disease risks across multiple states, years, and interest groups. *Human Dimensions of Wildlife*, 11, 215–220.
- Needham, M. D., & Vaske, J. J. (2008). Hunter perceptions of similarity and trust in wildlife agencies and personal risk associated with chronic wasting disease. *Society and Natural Resources*, 21, 197–214.

- Needham, M. D., Vaske, J. J., & Manfredi, M. J. (2004). Hunters' behavior and acceptance of management actions related to chronic wasting disease in eight states. *Human Dimensions of Wildlife*, 9, 211–231.
- Needham, M. D., Vaske, J. J., & Manfredi, M. J. (2006). State and residency differences in hunter responses to chronic wasting disease. *Human Dimensions of Wildlife*, 11, 159–176.
- Petchenik, J. (2003). *Chronic wasting disease in Wisconsin and the 2002 hunting season: Gun hunters' first response*. Madison, WI: Bureau of Integrated Science Services, Wisconsin Department of Natural Resources.
- Raymond, G. J., Bossers, A., Raymond, L. D., O'Rourke, K. I., McHolland, L. E., Bryant, P. K., . . . Caughey, B. (2000). Evidence of a molecular barrier limiting susceptibility of humans, cattle, and sheep to chronic wasting disease. *The European Molecular Biology Organization (EMBO) Journal*, 19, 4425–4430.
- Siegrist, M., Cvetkovich, G., & Roth, C. (2000). Salient value similarity, social trust, and risk/ benefit perception. *Risk Analysis*, 20, 353–362.
- Siegrist, M., & Cvetkovich, G. T. (2000). Perception of hazards: The role of social trust and knowledge. *Risk Analysis*, 20, 713–719.
- Siegrist, M., Gutscher, H., & Earle, T. C. (2005). Perception of risk: The influence of general trust, and general confidence. *Journal of Risk Research*, 8, 145–156.
- Sjöberg, L. (2000). Factors in risk perception. *Risk Analysis*, 20, 1–11.
- Sjöberg, L. (2001). Limits of knowledge and the limited importance of trust. *Risk Analysis*, 21, 189–198.
- Slovic, P. (1987). Perception of risk. *Science*, 236, 280–285.
- Smith, P. A. (2013, November 6). Illinois finds success controlling chronic wasting disease. *Milwaukee Journal Sentinel*. Retrieved from <http://www.jsonline.com/sports/outdoors/illinois-finds-success-controlling-chronic-wasting-disease-b99136507z1-230916611.html>
- Vaske, J. J. (2010). Lessons learned from human dimensions of chronic wasting disease research. *Human Dimensions of Wildlife*, 15, 165–179.
- Vaske, J. J., Absher, J. D., & Bright, A. D. (2007). Salient value similarity, social trust and attitudes toward wildland fire management strategies. *Human Ecology Review*, 14, 223–232.
- Vaske, J. J., & Lyon, K. M. (2011). CWD prevalence, perceived human health risks, and state influences on deer hunting participation. *Risk Analysis*, 31, 488–496.
- 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, 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, 193–209.
- Viklund, M. J. (2003). Trust and risk perception in Western Europe: A cross-national study. *Risk Analysis*, 23, 727–738.
- Walls, J., Pidgeon, N., Weyman, A., & Horlick-Jones, T. (2004). Critical trust: Understanding lay perceptions of health and safety risk regulation. *Health, Risk, and Society*, 6, 133–150.
- Wasserberg, G., Osnas, E. E., Rolley, R. E., & Samuel, M. D. (2008). Host culling as an adaptive management tool for chronic wasting disease. *Journal of Applied Ecology*, 46, 457–466.
- 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. *Journal of Wildlife Management*, 66, 551–563.
- Winter, G., Vogt, C. A., & McCaffrey, S. (2004). Examining social trust in fuels management strategies. *Journal of Forestry*, 102, 8–15.
- Wisconsin Outdoor News. (2010). WI: *New state CWD plan now in place*. Retrieved from <http://www.outdoornews.com/October-2010/WI-New-state-CWD-plan-now-in-place/>