Human Dimensions in Wildlife Management Article

Hunter and Nonhunter Beliefs about Chronic Wasting Disease in Wisconsin

NICOLE T. STAFFORD, *Colorado State University, Fort Collins, CO 80523, USA*
MARK D. NEEDHAM, *Oregon State University, Corvallis, OR 97331, USA*
JERRY J. VASKE,[1] *Colorado State University, Fort Collins, CO 80523, USA*
JORDAN PETCHENIK, *Wisconsin Department of Natural Resources, Madison, WI 53707, USA*

ABSTRACT We examined beliefs of landowners who hunt and do not hunt regarding chronic wasting disease (CWD) and its management. We mailed surveys to a random sample of 973 Wisconsin, USA, landowners living in the CWD southwest disease eradication zone. Of 613 respondents, 360 (59%) were hunters and 253 (41%) were not hunters. We created multiple item indices to measure respondent beliefs about effects of CWD and its management. Hunters and nonhunters differed on 5 of 6 belief indices. Both groups were, on average, relatively neutral in their trust of the Wisconsin Department of Natural Resources but landowners who did not hunt reported slightly higher trust. Both groups were neutral or slightly agreed that CWD should be managed and they were concerned about deer (*Odocoileus* spp.) health and the safety of eating venison. Landowners who did not hunt were more likely than those who hunted to agree with these issues but effect sizes indicated these differences were minimal. Landowners who hunted were more concerned than nonhunters about effects of CWD on deer hunting. Cluster analyses indicated most nonhunting landowners were neutral or not concerned about CWD and its management, whereas most hunting landowners were concerned. Our results suggest that managers should use communication campaigns to increase awareness and mitigate concerns about CWD, increase trust and input related to the disease, and inform publics about CWD management strategies. (JOURNAL OF WILDLIFE MANAGEMENT 71(5):1739–1744; 2007)

DOI: 10.2193/2006-557

KEY WORDS beliefs, chronic wasting disease, hunters, landowners, nonhunters, trust, wildlife management.

Chronic wasting disease (CWD) is a fatal disease of deer (*Odocoileus* spp.), elk (*Cervus elaphus*), and moose (*Alces alces*; Spraker et al. 1997, Colorado Division of Wildlife 2005). The disease has been discovered in free-ranging herds in 11 states in the United States (CO, KS, IL, NE, NM, NY, SD, UT, WV, WI, WY) and in the Canadian provinces of Alberta and Saskatchewan (Needham et al. 2006). The disease is a transmissible spongiform encephalopathy (TSE) thought to be caused by an abnormal protein called a prion (Miller et al. 2004). Although infected animals can look healthy, CWD eventually causes weight loss, excessive salivation, abnormal behavior, and death in all infected animals (Williams et al. 2002). Chronic wasting disease is related to scrapie in sheep, bovine spongiform encephalopathy in cattle (mad cow disease), and variant Creutzfeld–Jakob disease (vCJD) in humans (McKintosh et al. 2003). Research suggests CWD is transmitted directly through interaction with infected animals and indirectly through contaminated environments (Miller et al. 2004, Johnson et al. 2006). Although there are similarities between CWD and other TSE diseases linked to humans (e.g., vCJD), there is no evidence to suggest CWD has caused any human health problems (Raymond et al. 2000, World Health Organization 2000, Salman 2003, Belay et al. 2004).

In Wisconsin, CWD was discovered in February 2002 after 3 white-tailed deer (*O. virginianus*) tested positive for the disease. In response, Wisconsin Department of Natural Resources (WDNR) established a 661-km^2 disease eradication zone (DEZ) in Dane and Iowa counties where these deer were harvested (WDNR 2006). The size of this original southwest DEZ was expanded to 2,174 km^2 in 2004. A second DEZ of 744 km^2 was established in southeastern Wisconsin in Rock and Walworth counties in 2004. The WDNR established a management goal of eradicating CWD within the free-ranging deer population in these areas in an attempt to rid the state of the disease. This aggressive, controversial, and unprecedented action received criticism in the academic literature and popular press (Heberlein 2004).

Included in the mission of all wildlife agencies such as WDNR is an attempt to inform and educate publics about wildlife-related topics (Eschenfelder 2006). Hunters are a traditional target audience for receiving CWD information because agencies are concerned that if hunters have incomplete or inaccurate knowledge about CWD, they may stop hunting in areas where the disease has been found (Needham et al. 2004, 2006). This reaction from hunters could negatively affect a state's economy (Bishop 2004).

Previous human dimensions research has examined hunters' behavioral responses to CWD, perceived risk and agency trust related to the disease, acceptance of CWD management actions, and information and knowledge about the disease (e.g., Heberlein 2004; Needham et al. 2004, 2006; Vaske et al. 2004, 2006). Less attention has focused on landowners' and nonhunters' beliefs about CWD and strategies for managing the disease (Needham and Vaske 2006, Vaske et al. 2006). Our research addresses this knowledge gap.

Landowners are an important constituency because they may have different beliefs than hunters and their support and cooperation with CWD control efforts are necessary for success. Communication efforts between landowners in the

[1] *E-mail: jerryv@warnercnr.colostate.edu*

DEZ and WDNR have been ongoing since 2002. The WDNR has provided landowners with information about CWD and its management through brochures, letters, and face-to-face discussion (WDNR 2006). Little is known, however, about the extent to which this information was received and understood by landowners and what landowners in the southwest DEZ believe about CWD and its management. Our objectives were to 1) compare beliefs about CWD and WDNR's program for managing the disease between landowners who hunt and do not hunt in Wisconsin's southwest DEZ and 2) suggest how this information may assist management and inform future research related to the disease.

METHODS

Data Collection

We drew our data from a larger study designed to develop a baseline understanding of landowners' responses to CWD in Wisconsin's southwest DEZ (Petchenik 2006). We mailed surveys to a random sample of 973 landowners in this DEZ. We obtained landowner names and addresses from tax listings. We used 4 mailings to administer surveys beginning in October 2004. We collected data under Colorado State University human subjects protocol number 03-149H.

Analysis Variables

Hunter participation.—We asked respondents if they were 1) a deer hunter, 2) not a deer hunter but did not oppose deer hunting, or 3) not a deer hunter and opposed deer hunting. We considered hunters the respondents who indicated they were a deer hunter. We considered nonhunters the respondents who indicated they were not a deer hunter and did not oppose deer hunting. Those who opposed deer hunting constituted <3% ($n = 15$) of respondents and we also classified them as nonhunters.

Trust.—Similar to previous research (e.g., Sjöberg 1999; Siegrist et al. 2000, 2001, 2003), we operationalized trust using 2 multiple-item indices. The first index included 4 survey items measuring respondents' trust in WDNR management. We asked respondents if they trusted WDNR to 1) make good deer-management decisions regarding CWD, 2) follow best available science to manage CWD, 3) properly address CWD in Wisconsin, and 4) provide adequate opportunities to listen to landowners' concerns about CWD.

The second index included 7 items measuring respondents' trust in information provided by WDNR. We asked respondents if they trusted WDNR to provide: 1) enough information to decide what actions to take regarding CWD, 2) the best available information on CWD, 3) truthful information about human safety issues regarding CWD, 4) timely information on CWD, 5) truthful information about deer population estimates, 6) truthful information on how CWD spreads, and 7) truthful information on the number of deer that have CWD in Wisconsin. We measured both indices of trust on 7-point scales of strongly disagree (1) to strongly agree (7).

CWD management.—We used 5 items to measure respondents' beliefs about CWD management in Wisconsin: 1) CWD should be eliminated from the wild deer population, 2) CWD should not be allowed to spread further in Wisconsin, 3) the wild deer population should be reduced in the DEZ, 4) the percentage of deer infected with CWD in the DEZ should not be allowed to increase, and 5) the state should do nothing to eliminate CWD from wild deer herds. We measured responses on 7-point scales of strongly disagree (1) to strongly agree (7).

Health concerns.—We used one index to measure concerns about human health related to CWD and one index to measure concerns about the health of deer in Wisconsin due to CWD. The first index contained 4 survey items asking respondents the extent to which they agreed: 1) CWD poses a risk to human health, 2) CWD may cause disease in humans if they eat venison from infected deer, 3) they have concerns about eating venison because of CWD, and 4) their family has concerns about eating venison because of CWD. We measured responses on 7-point scales of strongly disagree (1) to strongly agree (7).

The second index contained 5 items measuring concerns about the health of deer in Wisconsin due to CWD. We asked respondents if they were concerned about 1) the health of the Wisconsin deer population, 2) CWD spreading to all deer in Wisconsin, 3) CWD greatly reducing the Wisconsin deer population, 4) CWD killing the entire Wisconsin deer population, and 5) CWD killing the entire deer population in the DEZ. We measured responses on 9-point scales of not at all concerned (1) to extremely concerned (9).

Concerns about hunting.—We used a 4-item index to measure concerns about effects of CWD on deer hunting. We asked how concerned respondents were 1) that CWD control efforts might discourage hunters from hunting, 2) about not having enough healthy deer to hunt in Wisconsin, 3) about not having enough healthy deer to hunt in the DEZ, and 4) about the future of deer hunting in Wisconsin. We measured items on 9-point scales of not at all concerned (1) to extremely concerned (9).

Data Analyses

We used Cronbach alpha (α) to test reliability and internal consistency of multiple-item indices. We then used *t*-tests to analyze bivariate differences between hunter and nonhunter landowners in their 1) trust in WDNR management, 2) trust in WDNR information, 3) beliefs about CWD management, 4) concerns about human health, 5) concerns about deer health, and 6) concerns about hunting. We converted computed indices to standardized *z*-scores ($\bar{x} = 0$, SD = 1) and then performed a series of *K*-means cluster analyses of these 6 indices to examine multivariate differences between groups (hunters, nonhunters). Cluster analysis allows classification of individuals into smaller more homogeneous groups based on patterns of responses across variables or indices. We considered hunting participation the independent variable for analyses with other variables and indices considered dependent. We used point biserial

Table 1. Reliability analyses of variables measuring Wisconsin, USA, landowners' beliefs about trust in Wisconsin Department of Natural Resources (WDNR), chronic wasting disease (CWD) management, health concerns, and effects of CWD on hunting based on surveys conducted in the southwest disease eradiation zone (DEZ) in 2004.

Item	$\bar{x}$	SD	Item total correlation[a]	α if item deleted[b]	α[c]
Trust[d]					
Trust WDNR management					0.93
WDNR makes good deer management decisions regarding CWD	4.09	1.94	0.87	0.91	
WDNR follows best available science to manage CWD	4.48	1.94	0.86	0.91	
WDNR properly addresses CWD in WI	4.28	1.99	0.89	0.90	
WDNR provides adequate opportunities to listen to landowners' concerns about CWD	4.49	1.80	0.75	0.93	
Trust WDNR information					0.95
WDNR provides ...					
enough information to decide actions to take regarding CWD	4.62	1.76	0.78	0.94	
the best available information on CWD	4.71	1.81	0.86	0.94	
truthful information about human safety issues regarding CWD	4.74	1.76	0.80	0.94	
timely information on CWD	4.73	1.68	0.87	0.94	
truthful information about deer population estimates	4.47	1.93	0.77	0.95	
truthful information on how CWD spreads	4.81	1.77	0.87	0.94	
truthful information on the no. of deer that have CWD in WI	5.01	1.83	0.84	0.94	
Management actions[d]					0.88
CWD should be eliminated from wild deer population	4.86	1.84	0.80	0.83	
CWD should not be allowed to spread further in WI	5.16	1.76	0.76	0.84	
The wild deer population should be reduced in the DEZ	4.02	1.99	0.65	0.87	
The percentage of CWD-infected deer in the DEZ should not be allowed to increase	5.12	1.73	0.77	0.84	
The state should do nothing to eliminate CWD from wild deer herds[e]	5.23	1.99	0.60	0.88	
Health concerns					
Concerns about human health (safety of eating venison)[d]					0.81
CWD poses a risk to human health	4.88	1.79	0.40	0.81	
CWD may cause disease in humans if they eat venison from infected deer	4.34	1.74	0.64	0.77	
Because of CWD, I have concerns about eating venison	4.63	2.05	0.79	0.68	
Because of CWD, my family has concerns about eating venison	4.99	1.99	0.73	0.71	
Concerns about deer health[f]					
Because of CWD, I am concerned about ...					0.91
the health of the WI deer population	5.55	2.26	0.62	0.90	
CWD spreading to all deer in WI	5.10	2.50	0.77	0.88	
CWD greatly reducing the WI deer population	4.45	2.45	0.81	0.87	
CWD killing the entire WI deer population	3.40	2.45	0.79	0.87	
CWD killing the entire deer population in the DEZ	3.52	2.48	0.79	0.87	
Concerns about hunting[f]					
Because of CWD, I am concerned ...					0.82
that CWD control efforts might discourage hunters from hunting	4.80	2.67	0.38	0.82	
about not having enough healthy deer to hunt in WI	4.07	2.59	0.77	0.72	
about not having enough healthy deer to hunt in DEZ	4.26	2.71	0.77	0.71	
about the future of deer hunting in WI	4.91	2.62	0.69	0.75	

[a] Pearson correlation coeff. between score on individual item and sum of scores on remaining items.
[b] Cronbach's α when item removed from scale.
[c] Reliability coeff. for how well a set of items (variables) measures a single unidimensional latent construct.
[d] Variables coded on 7-point scales: (1) strongly disagree, (2) moderately disagree, (3) slightly disagree, (4) neither, (5) slightly agree, (6) moderately agree, (7) strongly agree.
[e] Variable reverse coded.
[f] Variables coded on 9-point scales from (1) not at all concerned to (9) extremely concerned.

correlation (r_{pb}), eta (η), and Cramer's V to compare relative size of effects between groups (hunters, nonhunters, clusters).

RESULTS

Landowners returned 613 usable mail surveys, yielding a 63% response rate after adjusting for undeliverables. A follow-up telephone nonresponse bias check indicated that nonrespondents' answers to survey questions were within ±5% of respondents' answers and these differences were not statistically significant ($\chi^2 < 3.66$, $t < 1.99$, $P > 0.056$). Of 613 landowners who responded to the mail survey, 360 (59%) were hunters and 253 (41%) were nonhunters.

Reliability Analyses

Trust in WDNR management contained 4 survey items and had a Cronbach alpha coefficient of $\alpha = 0.93$ (Table 1). Trust in WDNR information contained 7 items and $\alpha = 0.95$. For beliefs about CWD management (5 items) $\alpha = 0.88$. For concerns about the safety of eating venison (4

Table 2. Differences between Wisconsin, USA, landowners who hunt and do not hunt in their beliefs about trust in Wisconsin Department of Natural Resources (WDNR), chronic wasting disease (CWD) management, health concerns, and effects of CWD on hunting based on surveys conducted in the southwest disease eradiation zone in 2004.

Item	Hunter participation[a]		T	P	r_{pb}[b]
	Hunters	Nonhunters			
Trust[c]					
Trust WDNR management	4.13	4.67	3.81	<0.001	0.153
Trust WDNR information	4.54	4.97	3.32	0.001	0.133
Management actions[c]	4.64	5.19	4.35	<0.001	0.175
Health concerns					
Concern about human health[c]	4.53	5.04	4.20	<0.001	0.164
Concern about deer health[d]	4.36	4.47	0.59	0.556	0.024
Concern about hunting[d]	5.09	3.66	8.62	<0.001	0.332

[a] Cell entries are means ($\bar{x}$).
[b] Measure of strength of association when one measure is dichotomous and one is continuous.
[c] Variables coded on 7-point scales: (1) strongly disagree, (2) moderately disagree, (3) slightly disagree, (4) neither, (5) slightly agree, (6) moderately agree, (7) strongly agree.
[d] Variables coded on 9-point scales from (1) not at all concerned to (9) extremely concerned.

items) $\alpha = 0.81$ and for concerns about health of deer herds (5 items) $\alpha = 0.91$. The index measuring concerns about hunting due to CWD contained 4 items and $\alpha = 0.82$. Deleting any item from its respective index did not improve reliability. A Cronbach alpha coefficient ≥ 0.65 indicates that items are measuring the same concept and justifies combining items into a single index (Cortina 1993, Nunnally and Bernstein 1994). All Cronbach alpha coefficients exceeded 0.80, which supported combining items into their respective indices.

Bivariate Analyses

Hunters and nonhunters differed ($t \geq 3.32$, $P \leq 0.001$) for 5 of 6 dependent indices (Table 2). On average, nonhunters had slightly more trust than hunters in both WDNR management and information related to CWD. Hunters were relatively neutral in their trust, whereas nonhunters slightly trusted WDNR. Compared to hunters, nonhunters also agreed more strongly that CWD should be managed. The 2 groups differed on only one of the health concern indices. Compared to landowners who hunted, those who did not hunt were slightly more concerned about the safety of eating venison. The groups did not differ in concern about deer health due to CWD ($P = 0.556$). Effect sizes for the magnitude of these mean differences between hunters and nonhunters, however, ranged from $r_{pb} = 0.02$ to 0.18 and averaged 0.13, suggesting relatively minimal (Vaske et al. 2002) or small (Cohen 1988) differences between hunters and nonhunters.

Conversely, hunters slightly agreed that they were concerned about effects of CWD on deer hunting in Wisconsin, whereas nonhunters slightly disagreed ($P < 0.001$; Table 2). The effect size ($r_{pb} = 0.33$) suggests a typical (Vaske et al. 2002) or medium (Cohen 1988) mean difference between hunters and nonhunters in their concern about effects of CWD on hunting.

Multivariate Analyses

A series of 2 to 6 group K-means cluster analyses of the 6 dependent indices showed that a 4-group solution provided the best fit for the data. To validate this solution, we randomly sorted data and conducted a cluster analysis after each of 3 random sorts. These additional analyses supported the solution identifying 4 distinct groups of individuals (Table 3). The first cluster (17% of respondents) did not trust WDNR and was not concerned about CWD, its management, or its effect on hunting. Cluster 2 (33%) contained individuals who were relatively neutral in their trust of WDNR and concerns about CWD. The third cluster (29%) included individuals who trusted WDNR but were concerned about CWD and its management. Cluster 4 (21%) did not trust WDNR and was relatively concerned about CWD and its management.

More hunters (19%) than nonhunters (14%) were in cluster 1 (i.e., not concerned, no trust). More nonhunters (47%) than hunters (24%) were in cluster 2 (i.e., neutral beliefs). Nonhunters (29%) and hunters (29%) were equally likely to trust WDNR but were concerned about CWD (cluster 3). The remaining 29% of hunters and 11% of nonhunters did not trust WDNR and were concerned about CWD (cluster 4). Taken together, 61% of nonhunters were neutral or not concerned about CWD and its management, whereas 58% of hunters were concerned. The difference in cluster group membership between hunters and nonhunters was statistically significant ($\chi^2 = 47.23$, $P < 0.001$) and the effect size ($V = 0.28$) suggests that the magnitude of this difference was typical (Vaske et al. 2002) or medium (Cohen 1988).

DISCUSSION

Our first objective was to compare beliefs about CWD and WDNR's program for managing the disease between hunters and nonhunters residing in Wisconsin's southwest DEZ. Bivariate results showed that both hunters and nonhunters were neutral or slightly agreed: 1) with current CWD management actions, 2) they were concerned about the safety of venison, and 3) they trusted WDNR to manage CWD and inform constituents about the disease. Hunters were more concerned than nonhunters about effects of

Table 3. Differences between cluster groups of Wisconsin, USA, landowners in their beliefs about trust in Wisconsin Department of Natural Resources (WDNR), chronic wasting disease (CWD) management, health concerns, and effects of CWD on hunting based on surveys conducted in the southwest disease eradiation zone in 2004.

	Cluster groups[a,b]						
	1 $n = 97$	2 $n = 190$	3 $n = 170$	4 $n = 126$	F	P	η^c
Trust[d]							
Trust WDNR management	2.29	5.34	5.59	2.75	384.95	<0.001	0.816
Trust WDNR information	3.18	5.51	5.71	3.34	209.13	<0.001	0.721
Management actions[d]	3.00	4.29	5.91	5.23	144.48	<0.001	0.654
Health concerns							
Concern about human health[d]	3.44	4.68	5.34	4.90	41.99	<0.001	0.423
Concern about deer health[e]	1.96	3.56	6.60	4.68	309.77	<0.001	0.785
Concern about hunting[e]	2.88	2.93	6.16	6.00	240.96	<0.001	0.745

[a] Cell entries are means ($\bar{x}$).

[b] Cluster 1 included individuals who were not concerned about CWD and did not trust WDNR. Cluster 2 included individuals who were relatively neutral on most indices. Cluster 3 included individuals who were concerned about CWD but trusted WDNR. Cluster 4 included individuals who were concerned about CWD and did not trust WDNR.

[c] Measure of strength of association when one measure is categorical and one is continuous.

[d] Variables coded on 7-point scales: (1) strongly disagree, (2) moderately disagree, (3) slightly disagree, (4) neither, (5) slightly agree, (6) moderately agree, (7) strongly agree.

[e] Variables coded on 9-point scales from (1) not at all concerned to (9) extremely concerned.

CWD on hunting. Multivariate results showed that overall most nonhunters were neutral or not concerned about CWD and its management, whereas most hunters were concerned. Given that most human dimensions research on CWD has examined hunters' beliefs about CWD and its management, our study addresses an important knowledge gap by also focusing on landowners' and nonhunters' responses to the disease. Input from various publics is important and should be considered in agency management plans because broad support and cooperation with CWD management goals are necessary for success.

Our second objective was to suggest how our results may assist management of CWD and inform research related to the disease. For example, the minimal differences in many beliefs between landowners who hunt and do not hunt in the DEZ suggest that WDNR may not need to tailor most CWD communication campaigns and messages differently for these 2 groups.

Although both hunter and nonhunter landowners were neutral or slightly concerned about deer health due to CWD, hunters were substantially more concerned about effects of the disease on deer hunting in Wisconsin. This suggests WDNR has effectively communicated potential impacts of the disease on deer herds but may need to tailor specific information about relationships between CWD and hunting differently for hunters and nonhunters.

The WDNR may also need to improve or increase information and education campaigns aimed specifically at hunters residing in the DEZ because multivariate results showed that the majority of these hunters were concerned about CWD and its management. The majority of nonhunters and a large proportion of hunters, however, were relatively neutral in their concerns about CWD and its management. This impartiality or indecisiveness may pose problems for WDNR management efforts and communication campaigns. For example, if WDNR wants political and financial support for CWD control efforts, the agency would need to take steps to increase awareness and ensure that various publics care about the issue.

Trust is an integral component of developing public credibility of an agency and support of its management actions (Slovic 1993, Earle and Cvetkovich 1995, Cvetkovich and Löfstedt 1999, Vaske et al. 2004). On average, both hunter and nonhunter landowners were relatively neutral or slightly trusted WDNR's CWD information and management. Approximately 48% of hunters and 25% of nonhunters, however, had little trust in the agency. The WDNR should take steps to improve trust if its publics are to support management goals. A large proportion (29%) of both hunters and nonhunters trusted WDNR but were still concerned about CWD. Perhaps these respondents trusted WDNR to manage CWD but believed there are limits to the agency's knowledge of CWD and potential risks associated with the disease are beyond agency control. To mitigate concerns about CWD, agencies such as WDNR may need to do more to inform and educate their constituents about strategies for managing the disease (e.g., herd reduction).

Information and education campaigns by WDNR correctly claim that there is no known relationship between CWD and human health problems but also offer advice on safely handling harvested deer. These ambiguous messages may have heightened hunters' and nonhunters' concerns about CWD and may partially explain why both groups were neutral or slightly agreed that they were concerned about the safety of eating venison. Given the unknown link between CWD and human health, WDNR's cautionary messages about the disease are justified but may constrain the impact of communication campaigns.

Our results are based on surveys of Wisconsin residents.

We did not survey nonresidents. Nonresident hunters are an important public for WDNR to consider in decision-making and communication efforts because nonresidents spend millions of dollars on hunting licenses and related items (Needham et al. 2006). For example, in 2001 nonresident hunting expenditures in Wisconsin were estimated at $33 million (Bishop 2004). An estimated 19% decline in nonresident hunting participation occurred following discovery of CWD in Wisconsin, resulting in an estimated $6 million revenue loss for the state (Bishop 2004). Ensuring that nonresidents receive appropriate information and a voice in management decisions should be an agency priority. Research is required to improve understanding of nonresidents' beliefs about CWD and its management (Needham and Vaske 2006).

We surveyed landowners in Wisconsin's southwest DEZ. This area contains the highest prevalence of CWD in the state and WDNR communication campaigns have targeted landowners in this zone. Prevalence of CWD and extensive communication campaigns may have influenced respondents' beliefs about the disease. Wisconsin residents living outside this DEZ may have different beliefs about CWD and its management than those living in this DEZ. Future research is required to understand beliefs of Wisconsin residents living outside this DEZ.

MANAGEMENT IMPLICATIONS

Taken together, our results suggest that WDNR managers may need to: 1) not tailor CWD communication messages differently for hunters and nonhunters except for relationships between CWD and hunting, 2) increase public trust and input related to CWD, 3) provide more information and education to mitigate hunters' concerns about CWD and increase nonhunters' awareness of the disease, and 4) do more to inform publics about CWD management strategies. Our study should be viewed as a starting point for understanding landowner beliefs about CWD and its management. We encourage managers and researchers to implement theoretical and methodological approaches to improve understanding of the human dimensions of CWD.

LITERATURE CITED

Belay, E. B., R. A. Maddox, E. S. Williams, M. W. Miller, P. Gambetti, and L. B. Schonberger. 2004. Chronic wasting disease and potential transmission to humans. Emerging Infectious Diseases 10:1–14.

Bishop, R. C. 2004. The economic impacts of chronic wasting disease in Wisconsin. Human Dimensions of Wildlife 9:181–192.

Cohen, J. 1988. Statistical power analysis for the social sciences. Erlbaum, Hillsdale, New Jersey, USA.

Colorado Division of Wildlife. 2005. Hunter harvested moose tests positive for CWD. Colorado Division of Wildlife Press Release, 29 Sep, Denver, USA.

Cortina, J. M. 1993. What is coefficient alpha? An examination of theory and applications. Journal of Applied Psychology 78:98–104.

Cvetkovich, G., and R. Löfstedt. 1999. Social trust and the management of risk. Earthscan, London, United Kingdom.

Earle, T. C., and G. T. Cvetkovich. 1995. Social trust: toward a cosmopolitan society. Praeger Press, Westport, Connecticut, USA.

Eschenfelder, K. R. 2006. What information should state wildlife agencies provide on their websites. Human Dimensions of Wildlife 11:221–223.

Heberlein, T. A. 2004. Fire in the Sistine Chapel: how Wisconsin responded to chronic wasting disease. Human Dimensions of Wildlife 9: 165–179.

Johnson, C. J., K. E. Phillips, P. T. Schramm, D. McKensie, J. M. Aiken, and J. A. Pedersen. 2006. Prion adhere to soil minerals and remain infectious. PLos Pathogens 2:0001–0007.

McKintosh, E., S. J. Tabrizi, and J. Collinge. 2003. Prion diseases. Journal of NeuroVirology 9:183–193.

Miller, M. W., E. S. Williams, N. T. Hobbs, and L. L. Wolfe. 2004. Environmental sources of prion transmission in mule deer. Emerging Infectious Diseases 10:1003–1006.

Needham, M. D., and J. J. Vaske. 2006. Beliefs about chronic wasting disease risks across multiple states, years, and interest groups. Human Dimensions of Wildlife 11:215–220.

Needham, M. D., J. J. Vaske, and M. J. Manfredo. 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., J. J. Vaske, and M. J. Manfredo. 2006. State and residency differences in hunters' responses to chronic wasting disease. Human Dimensions of Wildlife 11:159–176.

Nunnally, J. C., and I. H. Bernstein. 1994. Psychometric theory. McGraw-Hill, New York, New York, USA.

Petchenik, J. 2006. Landowner responses to chronic wasting disease and its management in Wisconsin's southwest disease eradication zone. Bureau of Integrated Science Services, Wisconsin Department of Natural Resources Report PUB-SS-1022 2006, Madison, USA.

Raymond, G. J., L. D. Bossers, K. I. Raymond, K. I. O'Rourke, L. E. McHolland, M. W. Bryant, M. W. Miller, E. S. Williams, M. Smits, and B. Caughey. 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.

Salman, M. D. 2003. Chronic wasting disease in deer and elk: scientific facts and findings. Journal of Veterinary Medical Science 65:761–768.

Siegrist, M., G. T. Cvetkovich, and H. Gutscher. 2001. Shared values, social trust, and the perception of geographic cancer clusters. Risk Analysis 21:1047–1053.

Siegrist, M., G. Cvetkovich, and C. Roth. 2000. Salient value similarity, social trust, and risk / benefit perception. Risk Analysis 20:353–362.

Siegrist, M., T. C. Earle, and H. Gutscher. 2003. Test of a trust and confidence model in the applied context of electromagnetic field (EMF) risks. Risk Analysis 23:705–716.

Sjöberg, L. 1999. Risk perception by the public and by experts: a dilemma in risk management. Human Ecology Review 6:1–9.

Slovic, P. 1993. Perceived risk, trust, and democracy. Risk Analysis 13:675–682.

Spraker, T. R., M. W. Miller, E. S. Williams, D. M. Getzy, W. J. Adrian, G. G. Schoonveld, R. A. Spowart, K. I. O'Rourke, J. M. Miller, and P. A. Merz. 1997. Spongiform encephalopathy in free-ranging mule deer, white-tailed deer, and Rocky Mountain elk in north-central Colorado. Journal of Wildlife Diseases 33:1–6.

Vaske, J. J., J. A. Gliner, and G. A. Morgan. 2002. Communicating judgments about practical significance: effect size, confidence intervals, and odds ratios. Human Dimensions of Wildlife 7:287–300.

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

Vaske, J. J., N. R. Timmons, J. Beaman, and J. Petchenik. 2004. Chronic wasting disease in Wisconsin: hunter behavior, perceived risk, and agency trust. Human Dimensions of Wildlife 9:193–209.

Williams, E. S., M. W. Miller, T. J. Kreeger, R. H. Kahn, and E. T. Thorne. 2002. Chronic wasting disease of deer and elk: a review with recommendations for management. Journal of Wildlife Management 66: 551–563.

Wisconsin Department of Natural Resources [WDNR]. 2006. Chronic wasting disease in Wisconsin. <http://www.dnr.state.wi.us/org/land/wildlife/Whealth/issues/CWD/>. Accessed 25 Oct 2006.

World Health Organization. 2000. World Health Organization consultation on public health and animal transmissible spongiform encephalopathies: epidemiology, risk, and research requirements. World Health Organization, Geneva, Switzerland.

Associate Editor: Whittaker.