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Hunting Specialization and its Relationship to Participation in Response to Chronic Wasting Disease

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This article examines the influence of chronic wasting disease (CWD) on displacement and desertion among hunters of varying degrees of specialization. Data were obtained from surveys (n = 9,567) of resident and nonresident deer and elk hunters in eight states. Cluster analyses of hunters' skill, centrality, equipment, and experience revealed four specialization groups (casual, intermediate, focused, veteran). Hunters were shown hypothetical scenarios depicting CWD prevalence levels and human death from the disease, and asked what they would do (e.g., hunt in other states, quit hunting). If CWD conditions worsen (e.g., 50% prevalence, death), nonresidents were more likely to switch states (up to 46%); residents would quit (up to 38%). Among residents and nonresidents, casual hunters were most likely to quit (up to 61%); veterans were least likely (up to 23%). If CWD influences a greater proportion of casual hunters (i.e., newcomers) to quit, impacts on the future of hunting due to hunter recruitment could be catastrophic. Veteran residents were more inclined to switch states (up to 19%); casual residents were least likely to be displaced (up to 7%). For nonresidents, there were few differences among specialization groups regarding intention to switch states. Given that focused hunters exhib-

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ited low experience, but high skill and centrality, trajectories of specialization dimensions are not identical and do not increase in "lock step" fashion. Specialization, therefore, may be best suited for revealing styles of involvement and career stages in an activity rather than a linear continuum of progression.

KEYWORDS: *Recreation specialization, chronic wasting disease, hunting, risk behavior, displacement, wildlife management.*

Introduction

Chronic wasting disease (CWD) has generated considerable concern among biologists, wildlife managers, hunters, and other stakeholders (Williams, Miller, Kreeger, Kahn, & Thorne, 2002). CWD is a neurological disease of deer (*Odocoileus* spp.), elk (*Cervus elaphus*), and moose (*Alces alces*) (Colorado Division of Wildlife, 2005; Williams & Young, 1980, 1982). In all infected animals, the disease causes excessive salivation, loss of coordination, abnormal behavior, emaciation, and death. CWD belongs to a family of transmissible spongiform encephalopathy (TSE) diseases such as bovine spongiform encephalopathy in cattle (i.e., BSE, mad cow), scrapie in sheep, and Creutzfeldt-Jakob disease in humans (McKintosh, Tabrizi, & Collinge, 2003). No evidence exists to suggest that CWD is a human health risk, but the possibility of transmission to humans cannot be dismissed (Belay et al., 2004; Raymond et al., 2000; Salman, 2003).

CWD has been found in free-ranging deer and elk in 11 states (Colorado, Illinois, Kansas, Nebraska, New Mexico, New York, South Dakota, Utah, West Virginia, Wisconsin, Wyoming) and two provinces (Alberta, Saskatchewan). The disease was also recently discovered in moose in Colorado (Colorado Division of Wildlife, 2005). Hunting declines attributable to CWD have occurred in some states (Heberlein, 2004; Vaske, Timmons, Beaman, & Petchenik, 2004). If CWD conditions continue to worsen, several states may experience a substantial decrease in hunting participation (Needham, Vaske, & Manfredo, 2004). Little is known, however, about whether changes in participation may differ among subgroups of hunters.

Compared to novices or newcomers, hunting is more central to the lifestyle of specialized hunters who devote more time and effort to the sport (Kuentzel & Heberlein, 1992; Miller & Graefe, 2000). It is possible that specialized hunters are less likely to be distracted by CWD or allow it to alter their hunting behavior. This article examines the extent to which CWD may influence hunters to hunt in other states or stop hunting permanently, and whether this displacement and desertion differ among subgroups of hunters based on their degree of recreation specialization in the activity.

Review of Literature

Human Dimensions of CWD

In North America, hunting participation has decreased (Brown, Decker, Siemer, & Enck, 2000; Heberlein & Thompson, 1996). Some of this decline

can be attributed to personal (e.g., age, lack of time) and situational (e.g., lack of available land to hunt, too many regulations) constraints (Miller & Vaske, 2003). Wildlife agencies are concerned that hunters' perceptions of possible unknown risks associated with CWD may erode their confidence and willingness to hunt in states where the disease is found (Gigliotti, 2004). Declines in hunting due to CWD are problematic because they can: (a) reduce license sale revenues, (b) limit an agency's ability to manage game species, (c) decrease support for wildlife agencies, (d) impact wildlife management programs (e.g., pheasant stocking) if funds get diverted to address CWD, and (e) constrain cultural traditions and the social and economic stability of communities dependent on hunting (Needham et al., 2004).

Given these potential consequences, research has focused on the extent to which hunters might change their behavior in response to CWD (Gigliotti, 2004; Miller, 2003, 2004; Needham et al., 2004; Vaske, Needham, Newman, Manfredo, & Petchenik, 2006; Vaske et al., 2004). Studies have presented hunters with hypothetical scenarios depicting manipulated levels of CWD prevalence (e.g., 1% or 5% deer or elk infected). Hunters reported their behavioral intentions for each scenario (e.g., continue or stop hunting). Between 10% and 20% of Wisconsin and South Dakota deer hunters, for example, reported that they would stop hunting in the management unit (i.e., agency-defined zones for hunting within county/state) that they hunt in most often if 5% to 20% of its deer had CWD (Gigliotti, 2004; Vaske et al., 2004). Less than 10% of Illinois deer hunters would quit if CWD was in or adjacent to the county where they hunted (Miller, 2004).

These studies manipulated relatively minor CWD prevalence levels and most hunters would not change their hunting behavior. Risk researchers, however, have identified two primary determinants of human behavior in response to risk judgments: (a) high probability of a hazard occurring, and (b) consequences/severity associated with the hazard (e.g., Adams & Smith, 2001; Sjöberg, 1999; Stonehouse & Mumford, 1994; Thompson & Dean, 1996). In some free-ranging deer and elk herds, the probability of encountering an animal infected with CWD is relatively high with prevalence rates exceeding 20% (Gross & Miller, 2001; Miller et al., 2000; Wolfe et al., 2002). Higher prevalence (e.g., 90%) has been documented in captive herds (Williams & Young, 1980). Although there is no evidence of human health consequences naturally attributable to CWD, laboratory research has shown that transmission of the disease to humans may occur (Belay et al., 2004; Raymond et al., 2000). In addition, CWD is similar to other TSE diseases that can cause human death (e.g., variant of Creutzfeldt-Jakob disease) (McKintosh et al., 2003).

Needham et al. (2004) found that if CWD prevalence ever increased dramatically (e.g., 50% infection rate), up to 49% of hunters would stop hunting deer or elk in several states. The decline would be even greater (e.g., 65%) if high prevalence is combined with threats to human health such as death from CWD. Nonresident hunters were more likely than residents to report that they would stop hunting. Little is known, however, about

the extent to which CWD may differentially influence other subgroups of hunters to change their behavior. This article addresses this knowledge gap by examining the influence of CWD on displacement and desertion among hunters of varying degrees of specialization in the activity.

Recreation Specialization

Hunters are heterogeneous, exhibiting a range of skills and behavior (Kuentzel & Heberlein, 1992; Miller & Graefe, 2000). Given the diversity among participants in a single activity, researchers have emphasized the importance of differentiating users into meaningful homogeneous groups (Manfredo & Larson, 1993; Vaske, Beaman, Stanley, & Grenier, 1996). Recreation specialization is a concept for segmenting recreationists into subgroups based on "a continuum of behavior from the general to the particular, reflected by equipment and skills used in the sport and activity setting preferences" (Bryan, 1977, p. 175). At one end of the continuum are novices or infrequent participants who do not consider the activity to be a central life interest or show strong preferences for equipment and technique. The other end includes more avid participants who are committed to the activity and use sophisticated methods. Recreationists are thought to progress to higher stages along the continuum, reflected by increasing skill and commitment (Bryan, 1977; Scott & Shafer, 2001).

The specialization concept has been examined relative to individuals engaged in a variety of activities in different settings (see Manning, 1999; Scott & Shafer, 2001 for reviews). Highly specialized recreationists can differ from their less specialized counterparts on attributes such as motivations (e.g., Chipman & Helfrich, 1988; McFarlane, 1994; Scott, Menzel Baker, & Kim, 1999), management and setting preferences (e.g., Martin, 1997; Scott & Thigpen, 2003; Virden & Schreyer, 1988), crowding evaluations (Graefe, Donnelly, & Vaske, 1985; Needham, Rollins, & Vaske, 2005), and place attachment (Bricker & Kerstetter, 2000).

Research on the relationship between specialization and hunting behavior has provided mixed results. Kuentzel and Heberlein (1992), for example, found specialization to be unrelated to hunters' participation behavior, concluding that participation may be a function of constraints such as proximity and social role identity. Conversely, Barro and Manfredo (1996) reported that experienced hunters were less likely than novices to allow management regulations to influence their participation. This article explores whether hunting displacement (i.e., participate in other areas due to adverse changes in recreation setting such as CWD) and desertion (i.e., quit) due to CWD differs among subgroups of hunters based on their degree of specialization in the activity.[1]

[1] Research has identified various types of displacement including temporal (i.e., altering time of participation) and spatial (i.e., altering location of participation) displacement (e.g., Hall & Shelby, 2000). Given that deer/elk hunting seasons in most states are primarily in the fall and winter months, temporal displacement due to CWD is unlikely. This study, therefore, examines hunter desertion and spatial displacement (i.e., hunt in other states) in response to CWD.

There is little consensus among researchers about how best to measure recreation specialization (Scott & Shafer, 2001). Both single-item (e.g., frequency of participation; Ditton, Loomis, & Choi, 1992) and multidimensional approaches have been employed to segment recreationists (e.g., Bricker & Kerstetter, 2000; Donnelly, Vaske, & Graefe, 1986; Lee & Scott, 2004). Researchers generally agree, however, that specialization is a multidimensional concept consisting of behavioral, cognitive, and affective components (McFarlane, 2004; Scott & Shafer, 2001). Behavioral indicators include experience (e.g., Kuentzel & McDonald, 1992; McFarlane, Boxall, & Watson, 1998) and equipment investment (e.g., Donnelly et al., 1986; Martin, 1997; McFarlane & Boxall, 1996). Cognitive indicators include skill (e.g., Needham et al., 2005; Ninomiya & Kikuchi, 2004; Vaske, Dyar, & Timmons, 2004) and knowledge (e.g., Kerstetter, Confer, & Graefe, 2001; Lee & Scott, 2004). Indicators of affective attachment/commitment include enduring involvement (McFarlane, 2004; McIntyre & Pigram, 1992) and centrality to lifestyle (e.g., Chipman & Helfrich, 1988; Scott & Thigpen, 2003).

Researchers are not always clear about relationships among these dimensions and whether indicators measure one dimension or another (Scott, Ditton, Stoll, & Eubanks Jr., 2005). Centrality, for example, has been measured by whether a participant belongs to organizations associated with an activity and/or owns related magazines and books (e.g., Donnelly et al., 1986; McFarlane, 1994). Others, however, have defined centrality as the extent to which a person's life is centered around an activity, generally measured by items such as "much of my life is organized around this activity" (Barro & Manfredo, 1996; McIntyre, 1989).

The majority of specialization studies have situated recreationists along a linear continuum using single items (Ditton et al., 1992) or the sum of standardized scores from various dimensions (e.g., Donnelly et al., 1986; Dyck, Schneider, Thompson, & Virden, 2003; Kerstetter et al., 2001). This continuum is treated as continuous (Virden & Schreyer, 1988) or subdivided into halves, thirds, or quartiles to represent degrees of specialization in an activity (e.g., low, medium, high specialization) (e.g., Dyck et al., 2003; Kerstetter et al., 2001).

Although this summative approach has merits in its simplicity, it is based on researcher-determined groups, assumes that dimensions covary, and obscures explanatory detail of each dimension (McIntyre & Pigram, 1992; Scott et al., 2005). Confirmatory factor analyses revealed that single-item summative approaches may be inappropriate (Lee & Scott, 2004). Researchers have suggested that dimensions be examined separately for their individual effects because they may not always increase linearly in "lock step" fashion (Kuentzel & McDonald, 1992; Scott et al., 1999; Scott & Thigpen, 2003). Some recreationists, for example, may participate regularly and become committed to an activity, but exhibit low skill; others may partake infrequently, yet display attributes of skill and commitment (Scott et al., 2005; Scott & Shafer, 2001).

Contrary to single-item and summative approaches, the use of cluster analysis as a multivariate technique to empirically segment groups of partic-

ipants in an activity introduces less researcher bias and does not assume that individual dimensions of specialization covary (Scott et al., 2005; Scott & Thigpen, 2003). Although cluster analysis is descriptive and selection of the final cluster solution requires researcher judgment, it may be a more appropriate method for classifying and describing different types of participants or subgroups within a given activity (Lee & Scott, 2004; McFarlane, 1994, 2004; Scott et al., 2005).

This article examines the relationship between hunters' specialization and their behavioral intentions in response to CWD. Two questions are addressed. First, to what extent may potential CWD prevalence levels and human health risks influence hunters to permanently stop hunting or travel to other states to hunt? Second, could this desertion and displacement differ among subgroups of hunters based on their degree of hunting specialization?

Methods

Data Collection

Data were obtained from mail surveys of nonresident and resident deer hunters in eight states (Arizona, Colorado, Nebraska, North Dakota, South Dakota, Utah, Wisconsin, Wyoming) and elk hunters in three states (Colorado, Utah, Wyoming). CWD had been detected in free-ranging deer and/or elk in each of these states except Arizona and North Dakota. The study population consisted of hunters who were 18 years of age or older and purchased a nonresident or resident license to hunt deer or elk with a gun in 2003. Random samples of names and addresses were obtained from the wildlife/game and fish government agency of each participating state.

Three mailings were used to administer the surveys beginning in July 2004.[2] Hunters were sent a survey, postage-paid return envelope, and cover letter. Non-respondents were sent a postcard reminder two weeks after this initial mailing. A second full mailing (i.e., survey, return envelope, letter) was sent to non-respondents three weeks after the postcard reminder. Surveys were mailed to 22,320 hunters. In total, 773 surveys were undeliverable (e.g., moved, incorrect address) and 9,567 completed surveys were returned, yielding a 44% response rate (9,567/22,320 − 773). Sample sizes were 5,329 for nonresident hunters (50% response rate) and 4,238 (39% response rate) for residents (for details, see Needham, Vaske, & Manfredo, 2005).

To check for non-response bias, hunters who completed a survey were compared to those who did not. A sample of 785 non-respondents (376 nonresidents, 409 residents) was telephoned in November 2004 and asked nine survey questions. Responses to five questions were statistically different ($p < .001$) between respondents and non-respondents, but statistical signif-

[2]The mail survey was pre-tested in each state in 2003 with hunters who purchased a license to hunt deer or elk in 2002 ($n = 659$). Details are reported in Needham et al. (2004).

icance is inflated by large sample sizes (Vaske, Gliner, & Morgan, 2002). Effect sizes (V, r_{pb}) were $< .15$, indicating "weak" (Cohen, 1988) or "minimal" (Vaske et al., 2002) differences between the two groups. Non-response bias was thus not deemed a problem and data were not weighted based on the non-response check. In each state, however, more residents than nonresidents purchased a license to hunt deer or elk with a gun in 2003. Given that more surveys were received from nonresidents, data were weighted to reflect the population proportions of hunters.[3]

Independent Variables

Consistent with previous research (e.g., McFarlane, 2004; McIntyre & Pigram, 1992; Scott et al., 2005; Scott & Shafer, 2001; Scott & Thigpen, 2003), specialization was measured in terms of affective, cognitive, and behavioral dimensions.

Affective measures. Five variables were used to measure *centrality.* Hunters reported the extent to which they disagreed or agreed with four statements: (a) If I stopped deer hunting, an important part of my life would be missing; (b) Deer hunting is an annual tradition that has become important to me; (c) Participation in deer hunting is a large part of my life; and (d) Given the amount of effort that I have put into becoming a deer hunter, it would be difficult for me to find another activity to replace deer hunting. Responses were coded on 7-point scales from 1 "strongly disagree" to 7 "strongly agree." In addition, respondents were asked: If you could not participate in deer hunting, would you: 0 "not miss it at all," 1 "miss it slightly," 2 "miss it more than most of your other activities," or 3 "miss it more than all of your other activities?" These items are similar to those used in past studies (e.g., Bricker & Kerstetter, 2000; McIntyre, 1989).

Cognitive measures. Three variables measured hunters' *skill level and knowledge.* Respondents reported the extent to which they disagreed or agreed with: (a) Given the deer hunting skills/knowledge that I have developed, it is important that I continue to hunt deer; (b) Testing/improving my deer hunting skills is more important to me than harvesting a deer; and (c) I would describe my skill level in deer hunting as advanced or expert.

[3]The non-response check contained several questions used here for measuring specialization and behavior in response to CWD. Weights were calculated with equation: Weight = Population %/Sample %, where (Population % = number of 2003 hunters in stratum/number of 2003 hunters across all strata) and (Sample % = number of respondents in stratum/number of respondents across all strata). There were 22 weights representing total hunters across all strata (i.e., states, residency, species). Weight for Arizona resident deer hunters, for example, was (32,502 hunters in stratum/1,329,464 hunters across strata)/(396 respondents in stratum/9,567 respondents across strata) = 0.59. Across states and species hunted, there were 11 weights representing total resident hunters and 11 weights representing total nonresident hunters. Weight for Colorado nonresident elk hunters, for example, was (69,153 hunters in stratum/185,467 nonresident hunters across states and species)/(564 respondents in stratum/5,329 nonresident respondents across states and species) = 3.52. See Needham et al. (2005) for more details on weighting.

Responses were coded on 7-point scales from 1 "strongly disagree" to 7 "strongly agree."

Behavioral measures. Two variables were used to measure *equipment.* Hunters reported the extent to which they disagreed or agreed with two statements: (a) I have accumulated a lot of deer hunting equipment, and (b) I have invested a lot of money in deer hunting equipment. Responses were coded on the same 7-point agreement scale.

Hunting *experience* was measured with a single variable. Respondents were asked how many years in total that they have hunted deer in their life. To control for age, experience was expressed as a percentage and calculated with the following equation:

$$\text{Number of years hunted deer in life/age} * 100 = \text{proportion of life hunted deer} \quad (1)$$

For all of these specialization variables, elk hunting was substituted for deer hunting in surveys of elk hunters. Variables are generally consistent with those in Barro and Manfredo (1996).

Dependent Variables

Maps in the surveys depicted hypothetical scenarios of CWD human health risks and increasing prevalence among deer or elk in three zones across each state (Figure 1). With the exception of maps in the Arizona and North Dakota surveys, zone A represented the location where CWD had been detected in free-ranging herds and had the highest prevalence. For Arizona and North Dakota, zone A represented the most likely area for CWD to be

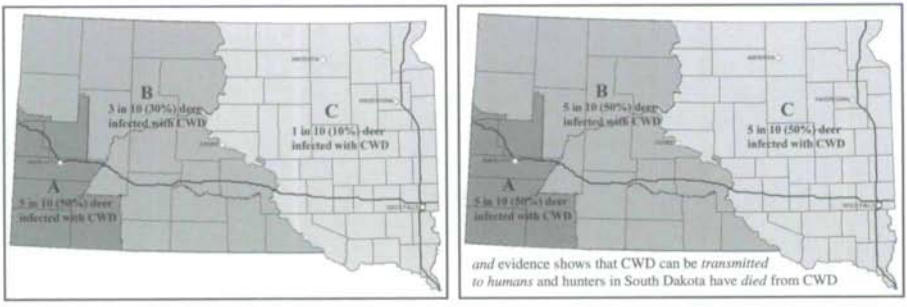

Figure 1. Sample maps (scenarios 3 and 6) depicting hypothetical scenarios of CWD prevalence, distribution, and human health risks.

Note. These maps were used in the surveys for South Dakota and are provided here as an example. For six of the states, zone A represented the area where CWD had already been detected and had the highest prevalence. For Arizona and North Dakota, zone A represented the opinions of the state wildlife/game and fish agencies regarding the most likely region for CWD to be first detected, if ever. All three zones were based on hunt management units, which often transect county borders (thin lines) and interstate highways (thick lines)

detected, if ever. Zone B either represented the location where CWD had been found but with lower prevalence than zone A, or was considered by the agency to be the area where CWD would spread to first from zone A. Zone C was considered by each agency to be the least likely location for high CWD prevalence levels to occur. All three zones for each state were based on hunt management units and the decision of where to situate the zones was made by the state's wildlife/game and fish agency.

Survey maps for all eight states depicted four separate hypothetical scenarios of increasing CWD prevalence and distribution: (a) 10% prevalence in zone A, 0% in zones B and C; (b) 30% in zone A, 10% in zone B, 0% in zone C; (c) 50% in zone A, 30% in zone B, 10% in zone C; and (d) 50% in all three zones (i.e., across the entire state).

Surveys for four states (Arizona, North Dakota, South Dakota, Wisconsin) included two additional hypothetical scenarios related to CWD prevalence and human health risks: (a) 10% prevalence in zone A, 0% in zones B and C, and "evidence shows that CWD can be transmitted to humans and hunters in the state have died from CWD;" and (b) 50% in all three zones and "evidence shows that CWD can be transmitted to humans and hunters in the state have died from CWD." The scenarios reflected the two primary determinants of behavior in response to risk—probability of encountering a hazard and consequences/severity associated with the hazard (e.g., Sjöberg, 1999; Thompson & Dean, 1996).[4] To emphasize the hypothetical nature of the scenarios, respondents were assured in the survey that the scenarios did not necessarily reflect current conditions and/or consequences to humans.

To measure behavioral intentions in response to CWD, hunters evaluated each scenario and indicated if they would: (a) "hunt deer in the zone in the state that they hunt deer in most often;" (b) "hunt deer in the state, but switch to a different zone;" (c) "give up deer hunting in the state, but hunt deer in another state" (i.e., displacement); or (d) "give up deer hunting altogether" (i.e., desertion). The respective state name was provided in responses for each survey and elk hunting was substituted for deer hunting in surveys of elk hunters. Given that few hunters ($< 10\%$) reported that they would switch to a different zone in the state for each scenario, the first two responses were collapsed into a single category labeled "still hunt in the state."

Data Analysis

Construct validity of the variables measuring the latent dimensions/factors of hunter specialization (i.e., centrality, skill, equipment, experience) was assessed using second-order confirmatory factor analysis (CFA) models.

[4]Further support for using prevalence and human health risks as determinants of hunter behavior in response to CWD was obtained from open-ended questions in the pre-test that asked hunters to list circumstances related to CWD that would cause them to give up deer/elk hunting in the state or permanently. The most dominant responses were related to CWD prevalence (89%) and potential human health risks/death (77%).

Second-order CFAs were performed for nonresidents and residents to test the extent to which: (a) the variables measuring these first-order factors provided a good fit, and (b) these first-order factors were explained by a higher second-order latent factor (i.e., hunter specialization).

EQS 6.1 software and robust estimation to correct for multivariate nonnormality were used, as data skewness and kurtosis indicated violations of the normal distribution assumption (Byrne, 1994; Chou & Bentler, 1995). Evaluation was based on the Satorra-Bentler scaled chi-square (S-B χ^2). Large sample sizes inflate this statistic. Model fit was assessed with robust corrected: comparative fit index (CFI*), non-normed fit index (NNFI*), and root mean square error of approximation (RMSEA*). RMSEA values $\leq .08$ and CFI and NNFI values $\geq .90$ indicate acceptable fit (Browne & Cudeck, 1993). Robust corrected standard errors were used to calculate test statistics. Errors were not permitted to correlate.

Responses to the variables were converted to standardized *z*-scores ($M = 0$, $SD = 1$). Internal consistency of the variables measuring the centrality, skill, and equipment dimensions was examined using Cronbach alpha reliability coefficients. Mean composite indices were computed for centrality, skill, and equipment. K-means cluster analysis was performed on these indices and the experience variable to segment hunters into specialization groups. Bivariate analyses (e.g., χ^2) then compared responses to the CWD scenarios among these groups. Given that Needham et al. (2004) reported that nonresidents and residents can differ in their responses to CWD, analyses were performed separately for these two groups. Due to the large sample sizes, a significance level of $p \leq .001$ was selected and effect size measures (e.g., V, η) were reported where appropriate. SPSS 13.0 software was used for these analyses.

Results

Validity and Reliability of Specialization Dimensions

Second-order CFAs demonstrated that the data provided an acceptable fit for nonresidents and residents (Figure 2). First-order factor loadings ranged from .67 to .92 for centrality, .46 to .89 for skill, and .91 to .97 for equipment. Centrality (loadings = .86 nonresidents, .84 residents) and skill (.83, .81) dimensions represented hunter specialization (i.e., second-order factor) better than equipment (.74, .68) and experience (.51, .40). All loadings were significant at $p < .001$. S-B χ^2 values were significant at $p < .001$, but this is a function of sample size. Acceptable fit indices demonstrated construct validity (CFI* = .93, .94; NNFI* = .91, .92; RMSEA* = .08).[5]

Additional support for combining variables into their associated dimensions was evident from reliability analyses. Tables 1 and 2 show the reliability

[5]Ancillary analyses tested single factor models (i.e., all 11 observed variables forced to load on one factor). These models did not withstand any criteria for reasonable fitting models (CFI* and NNFI* = .73 to .79; RMSEA* = .14 to .15), suggesting that traditional single item or summative approaches to measure specialization may be inappropriate.

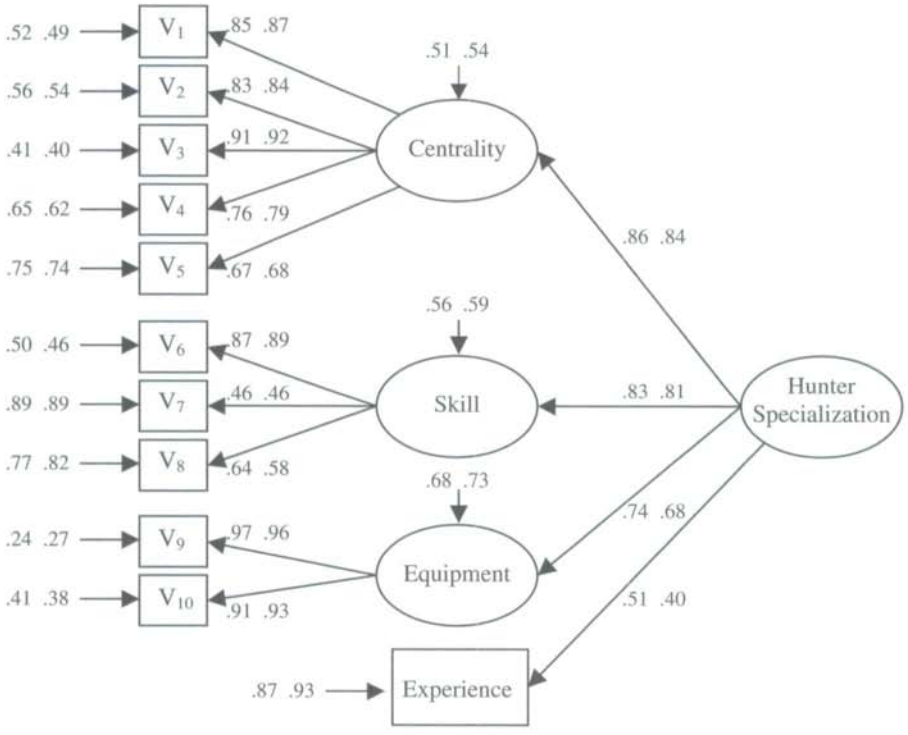

Figure 2. Second-order CFAs of four-dimensional measurement model of hunter specialization.

Note. First path loadings/coefficients = *nonresidents*, second path loadings/coefficients = *residents*. All loadings/coefficients are standardized. All loadings $p < .001$. Based on Satorra-Bentler robust estimation for multivariate non-normality, model fit indices: *Nonresidents*: S-B $\chi^2(42) = 1360.32$, $p < .001$, NNFI* = .91, CFI* = .93, RMSEA* = .08; *Residents*: S-B $\chi^2(42) = 1140.09$, $p < .001$, NNFI* = .92, CFI* = .94, RMSEA* = .08. See Tables 1 and 2 for variables/items corresponding to codes (e.g., V_1)

coefficients for nonresidents and residents, respectively. The Cronbach alpha values were .91 (residents and nonresidents) for centrality, .68 (residents) to .70 (nonresidents) for skill, and .94 (residents and nonresidents) for equipment. Deletion of any variable from its respective dimension did not improve reliability. Reliability of the overall specialization index was high (α = .85 nonresidents, .81 residents).

Cluster Analysis of Specialization Dimensions

Having demonstrated reliability and construct validity, standardized scores were combined to create an index for each dimension. Cluster analysis of these dimensions revealed four distinct groups of hunters labeled: (a)

TABLE 1
Reliability Analyses of Specialization Dimensions for Nonresident Hunters

Specialization dimensions and items	Item code	*M*	*SD*	Item total correlation	Alpha (α) if deleted	Cronbach's alpha (α)
Centrality						.91
If I stopped deer/elk hunting, an important part of my life would be missing[1]	V_1	6.01	1.42	.80	.87	
Deer/elk hunting is an annual tradition that has become important to me[1]	V_2	6.11	1.40	.76	.88	
Participation in deer/elk hunting is a large part of my life[1]	V_3	5.66	1.57	.85	.86	
Given effort I have put into deer/elk hunting, it would be difficult to find a replacement activity[1]	V_4	5.15	1.80	.72	.89	
If I could not deer/elk hunt, I would . . .[2]	V_5	1.93	0.70	.64	.90	
Skill[1]						.70
Given the deer/elk hunting skills/knowledge I have developed, it is important I continue to hunt	V_6	5.90	1.39	.57	.52	
Testing/improving my deer/elk hunting skills is more important to me than harvesting an animal	V_7	5.42	1.51	.45	.68	
I would describe my skill level in deer/elk hunting as advanced or expert	V_8	4.95	1.56	.51	.60	
Equipment[1]						.94
I have accumulated a lot of deer/elk hunting equipment	V_9	5.76	1.45	.88	—	
I have invested a lot of money in deer/elk hunting equipment	V_{10}	5.79	1.44	.88	—	
Experience[3]	V_{11}	40.6	26.6	—	—	—
Overall specialization index						.85

[1]Items coded on 7-point scale: 1 = strongly disagree, 2 = moderately disagree, 3 = slightly disagree, 4 = neither, 5 = slightly agree, 6 = moderately agree, 7 = strongly agree.
[2]Item coded on 4-point scale: 0 = not miss it at all, 1 = miss it slightly, 2 = miss it more than most of my other activities, 3 = miss it more than all of my other activities.
[3]Item calculated as: (number of years hunted deer or elk in life/age * 100) = proportion of life hunted deer or elk (%).

TABLE 2
Reliability Analyses of Specialization Dimensions for Resident Hunters

Specialization dimensions and items	Item code	*M*	*SD*	Item total correlation	Alpha (α) if deleted	Cronbach's alpha (α)
Centrality						.91
If I stopped deer/elk hunting, an important part of my life would be missing[1]	V_1	5.88	1.49	.82	.88	
Deer/elk hunting is an annual tradition that has become important to me[1]	V_2	6.19	1.22	.78	.89	
Participation in deer/elk hunting is a large part of my life[1]	V_3	5.61	1.57	.86	.87	
Given effort I have put into deer/elk hunting, it would be difficult to find a replacement activity[1]	V_4	5.10	1.85	.75	.90	
If I could not deer/elk hunt, I would . . .[2]	V_5	1.84	0.75	.66	.91	
Skill[1]						.68
Given the deer/elk hunting skills/knowledge I have developed, it is important I continue to hunt	V_6	5.81	1.43	.56	.48	
Testing/improving my deer/elk hunting skills is more important to me than harvesting an animal	V_7	5.25	1.63	.44	.64	
I would describe my skill level in deer/elk hunting as advanced or expert	V_8	4.95	1.55	.47	.61	
Equipment [1]						.94
I have accumulated a lot of deer/elk hunting equipment	V_9	5.56	1.57	.89	—	
I have invested a lot of money in deer/elk hunting equipment	V_{10}	5.51	1.62	.89	—	
Experience [3]	V_{11}	49.3	21.4	—	—	—
Overall specialization index						.81

[1]Items coded on 7-point scale: 1 = strongly disagree, 2 = moderately disagree, 3 = slightly disagree, 4 = neither, 5 = slightly agree, 6 = moderately agree, 7 = strongly agree.

[2]Item coded on 4-point scale: 0 = not miss it at all, 1 = miss it slightly, 2 = miss it more than most of my other activities, 3 = miss it more than all of my other activities.

[3]Item calculated as: (number of years hunted deer or elk in life/age * 100) = proportion of life hunted deer or elk (%).

casual hunters, (b) intermediate hunters, (c) focused hunters, and (d) veteran hunters.[6] Table 3 shows the distribution of these groups for nonresidents and residents. The distributions differed significantly, $\chi^2(3, N = 9387) = 194.77$, $p < .001$. Proportions of casual and veteran hunters were similar, but there were more intermediate hunters among residents and more focused hunters among nonresidents. This difference among groups, however, was relatively "minimal" (Vaske et al., 2002) or "weak" (Cohen, 1988), as the Cramer's *V* effect size was .14. Similar to past research, the largest proportion of hunters (39% to 41%, Table 3) was classified as veterans (i.e., highly specialized) (Barro & Manfredo, 1996; Miller & Graefe, 2000).

These four groups were compared in terms of their responses to the original specialization variables (Needham, 2006). Nonresident and resident casual hunters reported the lowest mean scores on all variables measuring centrality, skill, equipment, and experience; veterans had the highest scores. Intermediate hunters' responses fell in between the casual and veteran groups. This pattern among casual, intermediate, and veteran hunters is consistent with a continuum of specialization, as hypothesized by Bryan (1977). Focused hunters, however, had the second highest scores on all variables except for experience, as they only hunted deer or elk an average of 19% (nonresidents) and 28% (residents) of their lives. By comparison, intermediates hunted deer or elk an average of 60% (residents and nonresidents) and veterans participated 62% (residents) to 64% (nonresidents) of their lives. On average, casual hunters participated 11% (nonresidents) and 23% (residents) of their lives. ANOVA and Tamhane's T2 post-hoc tests showed that responses differed substantially among the four groups for nonresidents, $F(3, 4969 \text{ to } 5220) \leq 6001.79$, $p < .001$, $\eta \leq .88$, and residents, $F(3, 3975 \text{ to } 4166) \leq 2191.93$, $p < .001$, $\eta \leq .78$. Among the four groups, there were

TABLE 3
Specialization Cluster Group Membership for Nonresident and Resident Hunters[1]

	Nonresidents		Residents	
	Sample size (*n*)	Percent (%)	Sample size (*n*)	Percent (%)
Casual	838	16	635	15
Intermediate	688	13	1120	27
Focused	1640	32	722	17
Veteran	2058	39	1686	41

[1] $\chi^2(3, N = 9387) = 194.77$, $p < .001$, $V = .14$.

[6] A series of cluster analyses was performed ranging from two to seven clusters. The four-group solution provided the best fit for the data. To validate this solution, data were randomly sorted and a cluster analysis was conducted after each of three random sorts. All of these additional cluster analyses supported the four-group solution.

"minimal" (Vaske et al., 2002) or "weak" (Cohen, 1988) differences in age, state, education, income, and urban/rural residency, as suggested by the effect sizes (V, $\eta \leq .12$).

Hunters' Behavioral Intentions in Response to CWD

Almost all nonresident (96%) and resident (98%) hunters reported that they would continue hunting in the state if 10% of the deer or elk in zone A and 0% in the rest of the state had CWD (scenario 1; Tables 4 and 5). At this prevalence level, which is consistent with conditions in some states (e.g., Colorado, Wyoming), few hunters would give up deer or elk hunting in the state or altogether. More hunters, however, would alter their behavior as CWD conditions worsen. Up to 44% of nonresidents would switch states and 8% would quit altogether if prevalence increases to 50% across the state (scenario 4). Compared to nonresidents, residents were more likely to quit (23%) than switch states (14%) under these conditions. If high prevalence is combined with human death (scenario 6), declines could be even greater, as 46% of nonresidents and 15% of residents would switch states, and 18% of nonresidents and 38% of residents would quit.

Differences in Behavioral Intentions among Specialization Subgroups

Nonresident hunters' behavioral intentions in response to the CWD scenarios differed significantly among the four specialization groups, $\chi^2(6, N = 1123 \text{ to } 5093) \leq 195.28$, $p < .001$ (Table 4). Across all scenarios, the percentage that would quit deer or elk hunting permanently was highest for casual hunters followed by the intermediate, focused, and veteran groups. For example, 41% of casual hunters compared to 31% of intermediate, 19% of focused, and 10% of veteran hunters would quit if 50% of deer or elk across the state had CWD and humans died from the disease (scenario 6). Except for this worst case scenario where veterans were slightly more likely to switch states (51%) followed by focused (44%), intermediate (37%) and casual (33%) hunters, few differences existed among groups regarding their intentions to hunt in another state.

Table 5 shows that *resident* hunters' behavioral intentions in response to CWD also differed significantly among the four specialization groups, $\chi^2(6, N = 2425 \text{ to } 4072) \leq 365.56$, $p < .001$. Like nonresidents, the percentage that would give up deer or elk hunting permanently for each scenario was highest for casual hunters followed by the intermediate, focused, and veteran groups. In response to the sixth scenario (i.e., 50% across state, death), for example, casual hunters were more likely to quit (61%) followed by intermediate (52%), focused (28%), and veteran (23%) hunters. Unlike nonresidents, however, there were clear differences among groups in their intentions to switch to other states to hunt. Across all scenarios, the percentage that would switch states was highest for veterans followed by the focused, intermediate, and casual groups. For example, 18% of veterans compared to

TABLE 4
Behavioral Intentions of Nonresident Hunter Specialization Cluster Groups In Response to CWD[1]

Hypothetical scenarios and hunter specialization cluster groups	Behavioral intention			$\chi^2(6)$	Effect size (V)
	Still hunt in state	Switch to another state	Give up altogether		
Scenario 1 (10% A, 0% B, 0% C; no death)				53.68	.08
Casual	95	2	3		
Intermediate	95	4	1		
Focused	97	3	0		
Veteran	97	3	0		
Total	96	3	1		
Scenario 2 (30% A, 10% B, 0% C; no death)				50.20	.07
Casual	88	9	3		
Intermediate	89	9	2		
Focused	90	9	1		
Veteran	92	8	0		
Total	90	9	1		
Scenario 3 (50% A, 30% B, 10% C; no death)				164.05	.13
Casual	60	29	11		
Intermediate	70	23	7		
Focused	70	26	4		
Veteran	75	24	1		
Total	70	26	4		
Scenario 4 (50% A, 50% B, 50% C; no death)				195.28	.15
Casual	36	46	18		
Intermediate	45	45	10		
Focused	48	45	7		
Veteran	54	43	3		
Total	48	44	8		
Scenario 5 (10% A, 0% B, 0% C; death)[2]				35.43	.13
Casual	76	4	20		
Intermediate	77	11	12		
Focused	85	9	6		
Veteran	83	13	4		
Total	81	11	8		
Scenario 6 (50% A, 50% B, 50% C; death)[2]				83.07	.20
Casual	26	33	41		
Intermediate	32	37	31		
Focused	37	44	19		
Veteran	39	51	10		
Total	36	46	18		

[1]Cell entries for behavioral intentions are percents (%); all χ^2-values significant at $p < .001$.
[2]Only asked in surveys of Arizona, North Dakota, South Dakota, and Wisconsin hunters.

TABLE 5
Behavioral Intentions of Resident Hunter Specialization Cluster Groups In Response to CWD[1]

Hypothetical scenarios and hunter specialization cluster groups	Behavioral intention			$\chi^2(6)$	Effect size (V)
	Still hunt in state	Switch to another state	Give up altogether		
Scenario 1 (10% A, 0% B, 0% C; no death)				31.39	.07
Casual	97	0	3		
Intermediate	98	0	2		
Focused	99	1	1		
Veteran	99	1	0		
Total	98	1	1		
Scenario 2 (30% A, 10% B, 0% C; no death)				68.00	.09
Casual	91	1	8		
Intermediate	93	2	5		
Focused	95	2	3		
Veteran	96	2	2		
Total	94	2	4		
Scenario 3 (50% A, 30% B, 10% C; no death)				203.63	.16
Casual	71	4	25		
Intermediate	77	6	17		
Focused	83	8	9		
Veteran	86	9	5		
Total	81	7	12		
Scenario 4 (50% A, 50% B, 50% C; no death)				365.56	.21
Casual	48	7	45		
Intermediate	55	12	33		
Focused	65	16	19		
Veteran	71	18	11		
Total	63	14	23		
Scenario 5 (10% A, 0% B, 0% C; death) [2]				174.35	.19
Casual	70	2	28		
Intermediate	72	4	24		
Focused	83	5	12		
Veteran	87	7	6		
Total	79	5	16		
Scenario 6 (50% A, 50% B, 50% C; death) [2]				275.88	.24
Casual	33	6	61		
Intermediate	36	12	52		
Focused	54	18	28		
Veteran	58	19	23		
Total	47	15	38		

[1]Cell entries for behavioral intentions are percents (%); all χ^2-values significant at $p < .001$.
[2]Only asked in surveys of Arizona, North Dakota, South Dakota, and Wisconsin hunters.

16% of focused, 12% of intermediate, and 7% of casual hunters would travel to other states to hunt if 50% of deer or elk across the state had CWD (i.e., scenario 4). Effect sizes ($V = .07$ to .24) indicated "minimal" or "weak" to "typical" or "medium" relationships among nonresident and resident hunters' specialization and behavioral intentions in response to CWD conditions (Cohen, 1988; Vaske et al., 2002).[7]

Discussion

This article examined relationships between hunter specialization and behavioral intentions in response to CWD. Results showed that if potential CWD prevalence and human health risks increase, deer/elk hunting participation would substantially decrease. Nonresident hunters would be more inclined to travel to other states to hunt; residents would be more likely to give up the activity permanently. Among nonresidents and residents, casual hunters were most likely to give up the activity and veterans were least likely to quit. Veteran residents would be most inclined to switch to other states to hunt; casual residents were least likely to be displaced. For nonresidents, however, there were few differences among specialization groups regarding intentions to travel to other states to hunt. Findings have implications for management, theory, and research.

Management Implications

At current CWD prevalence levels (i.e., scenario 1) in some states (e.g., Colorado, Wyoming), almost all hunters would continue hunting deer/elk in their state. This suggests that agencies may experience only minor declines in revenue from hunting license sales if CWD conditions do not worsen. Serious ramifications may occur, however, if conditions deteriorate; 64% of nonresidents and 53% of residents would switch to other states or give up hunting altogether if half of the deer or elk ever have CWD and human death occurs from the disease (scenario 6). Although high prevalence and human death from CWD are unlikely, agencies should anticipate that CWD will likely cause some decline in license revenues, reduced support for wildlife programs and management, negative impacts on cultural and family traditions, and economic instability of communities dependent on hunting (Needham et al., 2004).

When specialization is considered, nonresident and resident casual hunters (i.e., novices or newcomers) were most likely to stop hunting permanently in response to CWD (i.e., up to 61%). Hunting participation has declined in North America (Brown et al., 2000) with hunters stopping due

[7]A similar proportion of: (a) nonresident and resident; and (b) casual, intermediate, focused, and veteran hunters participated in zone A, zone B, and/or zone C in 2003 and in their life. Ancillary analyses showed no substantial relationship between zones in which respondents hunted and behavioral intentions in response to each hypothetical scenario.

to constraints such as age, health, and limited access to some hunting areas (e.g., Miller & Vaske, 2003). If CWD influences a greater proportion of casual hunters (i.e., newcomers) to quit, impacts on the future of deer and elk hunting due to hunter recruitment could be catastrophic. Findings, however, showed that only 15% to 16% of hunters were classified as casual; the most (39% to 41%) were veterans. These veterans were least likely to give up deer or elk hunting. Although focused hunters may be relatively new to the activity, they were also less likely to report that they would quit compared to casual hunters. This suggests that desertion from hunting due to CWD may be greater among casual hunters, but this group represents a minority of hunters. The majority of respondents were focused or veteran hunters and less than 30% of these hunters would quit even if CWD ever reaches 50% prevalence and causes human death.

Although veterans were least likely to give up deer or elk hunting, they were most likely to travel to other states to hunt. Casual hunters were least likely to be displaced. This pattern was more pronounced for resident hunters. For nonresident hunters, there were few differences among specialization groups regarding intentions to travel to other states to hunt. This is predictable because regardless of their specialization, nonresidents have already hunted and/or purchased a license to hunt in states other than the states in which they reside. Findings here suggest that if CWD conditions deteriorate in a state, the wildlife agency could expect: (a) highest desertion among resident and nonresident casual hunters, (b) highest displacement among resident veteran hunters, and (c) relatively high displacement among nonresident hunters irrespective of their specialization. Taken together, the potential consequences of hunting declines and displacement attributable to CWD suggest the need for agencies and other stakeholders to engage in long-term and proactive efforts to address the disease (e.g., continue educating hunters about CWD and its management, reducing herds in CWD areas, testing animals for CWD) (Needham et al., 2004).

Theoretical Implications

Results both reinforce and contradict findings of past studies, and suggest other issues that require exploration. For example, unlike recent human dimensions research on CWD (e.g., Gigliotti, 2004; Miller, 2004), this article showed that potential CWD conditions could influence a large percentage of hunters to change their hunting behavior. Moreover, displacement and desertion in response to CWD differed between residents and nonresidents, and among subgroups of hunters based on their degree of specialization in the activity.

Past research on relationships between specialization and behavior has reported mixed results. Kuentzel and Heberlein (1992), for example, found few relationships between hunter behavior and specialization. Consistent with other studies, however, findings here suggest that the recreation specialization concept is useful for segmenting users and anticipating differ-

ences in potential behavior in response to changing recreation opportunities and resources (Barro & Manfredo, 1996; McFarlane, 2004; McFarlane et al., 1998).

Identical to recent research, specialization was treated as a multidimensional concept consisting of affective, cognitive, and behavioral components (Lee & Scott, 2004; McFarlane, 2004). Factor loadings from the second-order CFAs showed that affective (i.e., centrality) and cognitive (i.e., skill) dimensions represented hunter specialization better than behavioral dimensions (i.e., equipment, experience; Figure 2). These second-order CFA results are similar to Lee and Scott's (2004) study of birders, suggesting that specialization is multidimensional and best understood in terms of activity skill and centrality/importance; experience and equipment are less useful, but are still important dimensions of specialization. This model was superior to a summative approach, suggesting that a single specialization index may be imprudent.

Cluster analyses of the specialization dimensions (i.e., centrality, skill, equipment, experience) suggested that the trajectories of dimensions are not identical and progress in each dimension does not always increase linearly from low to high in "lock step" fashion (Lee & Scott, 2004; Scott & Thigpen, 2003). Focused hunters, for example, have spent a small proportion of their lives hunting, but are almost as skilled and committed as veterans. Given that specialization groups did not differ in age, focused hunters may have recently taken up and become immersed in hunting by purchasing necessary equipment and developing requisite skills. Socialization factors could have contributed, as focused hunters may have learned skills from friends or guides who are more specialized. A more probable explanation, however, is that hunting careers for some individuals may be characterized by multimodal participation patterns. Most hunters become involved in hunting as a child or youth and learn from their parents (O'Leary, Behrens-Tepper, McGuire, & Dottavio, 1987). Participation may decline when attending college or starting a career or family, but increase again later in life when teaching their children to hunt or when financial resources are available to afford costs associated with hunting. Specialization, therefore, may be best suited for revealing styles of involvement and career stages in an activity rather than a linear continuum of progression (Scott & Shafer, 2001).

Future Research

To increase the generalizability of these findings, the following future research considerations are offered. First, response categories for the hypothetical CWD scenarios ascertained whether hunters would continue hunting deer or elk in the state, switch to another state, or give up permanently. Hunters, however, may choose to hunt a different species instead. Research should examine other possible behavioral responses to CWD.

Second, identical to most research on both recreation specialization and the human dimensions of CWD, this article is quantitative and cross-sectional

in nature. Although the hypothetical scenarios described CWD prevalence and human health risks that may occur in the future, this study measured hunter specialization at one point in time. Longitudinal and panel design studies are needed to determine whether: (a) the four specialization groups progress to more advanced stages in hunting, and (b) hunting displacement and desertion in response to CWD conditions actually follow similar trends to those identified here. Qualitative approaches may provide depth and detail necessary for delineating underlying influences of hunter specialization and behavior in response to CWD (Scott & Shafer, 2001).

Third, focused hunters exhibited low experience, but high skill and centrality. Explanations of this group are clearly speculative; survey questions were not asked to determine hunters' socialization or participation patterns. Research is required to understand this group in more detail and determine whether similar groups exist in other activities.

Fourth, variables used here to measure specialization are generally consistent with past research (see Barro & Manfredo, 1996; Manning, 1999; Scott & Shafer, 2001 for reviews), but additional research is needed to confirm the validity and reliability of these and other items used to measure the concept. In addition, this study employed a single-item measure of experience (i.e., proportion of life hunted). Researchers should use multi-item measures of specialization dimensions whenever possible. Caution, however, should be exercised when adopting some measures of experience used in previous studies. More days of participation, for example, may not imply high specialization. Hunting regulations often permit only one or two animals to be harvested in a given season or year. Given their skill and ability, specialized hunters may reach their limit earlier, thus could have lower participation compared to unsuccessful hunters.

Fifth, recreation studies, including the study reported here, are often bound by human subject/regulatory compliance protocols that require participants to be over a certain age (e.g., 18 years). This may result in a lower proportion of novice or casual participants in a sample than what may exist in the population because younger participants may have lower rates of experience and lack the financial ability to purchase equipment for the activity. Research is needed to determine if such sampling issues significantly bias studies of recreation specialization.

Sixth, the hypothetical CWD scenarios in this study do not necessarily reflect current prevalence levels or consequences to humans. Increased testing of harvested animals for CWD (i.e., postmortem sampling), advancements in lymphoid and tonsillar biopsy techniques for testing live animals (i.e., antemortem sampling), and continued in-vitro laboratory experiments of CWD in human cells may provide a more realistic assessment of possible current and future CWD prevalence levels and human health risks (Raymond et al., 2000; Sigurdson et al., 1999; Wild, Spraker, Sigurdson, O'Rourke, & Miller, 2002).

Finally, the findings presented here are limited to resident and nonresident hunters across eight states that purchased a license to hunt deer or elk

with a gun in 2003. Results may not generalize to hunters participating in different forms of hunting (e.g., archery) or other species that have CWD (e.g., moose). The applicability of these findings to other activity groups remains a topic for further empirical investigation.

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