

**Chronic Wasting Disease in the United States: How Have Hunters and State Wildlife Agencies Responded?**

by

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Keywords: chronic wasting disease, CWD, deer management, *Odocoileus virginianus*, white tailed deer, wildlife disease management

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## Abstract

Chronic wasting disease (CWD), a fatal neurodegenerative disease that affects cervids, has been detected in 33 states across the United States. Currently there are no preventions, treatments, or cures for the disease in cervid populations, which makes the disease a significant looming threat for managers to address. Wildlife managers and decision-makers, due to presence and spread of CWD within states, are addressing the following challenges posed by CWD including negative impacts on cervid populations, drops in hunter participation, and related loss of revenue from hunting license sales. Impacts like the decline in hunting license sales could have serious repercussions for the way we fund conservation in the United States. Our first study sheds a greater light on some of the most pressing challenges and uncertainties facing wildlife managers, specifically examining what may cause hunters to stop hunting when CWD comes to their state. Our research studies hunter perceptions of risk, concern, and comfort associated with CWD in newly affected states. We found that hunter perceptions varied significantly, influenced by a variety of factors including demographics, hunting-specific demographics, hunting motivations, and proximity to detection. Thus, we concluded that hunter perceptions about the detection of CWD were not generalizable to a newly affected region. Additionally, we investigated the impact of state wildlife agency policies on annual CWD prevalence. States with written CWD management plans that had bans on baiting and natural cervid urine lures exhibited lower annual prevalence rates than states that permitted baiting. Conversely, states that had special CWD hunting opportunities (e.g. an additional season) and bans on rehabilitation of cervids within established CWD zones exhibited greater annual prevalence. These findings underscore the complexities of CWD management and emphasize the necessity of multifaceted approaches.

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## List of Abbreviations

CWD	Chronic Wasting Disease
U.S.	United States
VIF	Variance Inflation Factor
AFWA	Association of Fish and Wildlife Agencies
RT-QuIC	Real-time Quaking-induced Conservation

## List of Symbols

$\alpha$	Alpha (i.e., level of significance)
$M$	Mean
SD	Standard Deviation

## **Chapter 1. Southeastern deer hunter perceptions following initial detection of chronic wasting disease**

Keywords: chronic wasting disease; CWD; hunter concerns; *Odocoileus virginianus*; perceived risk; white-tailed deer

### **Abstract**

We investigated deer hunter perceptions of risk, concern, and comfort about chronic wasting disease (CWD) in newly affected states. Data were collected through a novel opportunistic survey which was implemented in the southeastern region of the United States in Alabama (n = 689) and Louisiana (n = 682) after the detection of CWD. Findings indicate that Alabama deer hunters exhibited a greater level of comfort hunting in regions with CWD detections, while also exhibiting greater concern about the prevalence rate of the disease compared to Louisiana deer hunters. Additionally, our study employed logistic regression models to determine factors that influence deer hunter perceptions. Factors influencing deer hunter perceptions varied between the two states and regionally, indicating that hunter perceptions are not generalizable. Educational materials and outreach opportunities that are tailored to hunter goals is necessary to mitigate the impact of CWD on deer hunting activities.

## Introduction

CWD is a fatal neurodegenerative disease that affects members of the Cervidae family, including white-tailed deer (*Odocoileus virginianus*), mule deer (*Odocoileus hemionus*), elk (*Cervus canadensis*), and moose (*Alces alces*) (Centers for Disease Control and Prevention, 2019). Since its original detection in 1967, CWD has been detected in 33 states across the United States (U.S.) and globally in Canada, Finland, Norway, South Korea, and Sweden (Richards, 2024; Williams & Young, 1980). To date, there are no preventions, treatments, or cures for the disease (Centers for Disease Control and Prevention, 2019); thus state wildlife agencies combat the disease with a variety of management actions. Without immediate implementation of management actions, the prevalence rate of CWD can increase drastically and negatively impact cervid populations (Belsare et al., 2021; DeVivo et al., 2017; Edmunds et al., 2016; Samuel, 2023; Uehlinger et al., 2016). Due to unique disease characteristics, intense management actions implemented immediately upon detection of CWD, such as targeted removal, have been effective at limiting the spread and prevalence of the disease in core endemic areas in Illinois and Colorado (Uehlinger et al., 2016; Wolfe et al., 2018).

Apart from its biological implications, CWD poses additional challenges to state wildlife agencies, as it can negatively impact hunter participation, and consequently, hunting license sales (Bishop, 2004). For example, the discovery of CWD in Wisconsin in 2002 led to a 11% decrease in hunting license sales the year after detection, resulting in a loss of \$33 million in hunting expenditures (Bishop, 2004). Additionally, the financial burden of combatting CWD is substantial, because states that have CWD must allocate funding to disease surveillance, management, and stakeholder education (Thompson & Mason, 2022). Collectively, these effects

translate into reduced financial resources available to state agencies for managing wildlife populations and their habitats.

Because hunting plays a key role in maintaining or reducing local deer abundance to combat CWD, and hunting license sales fund state wildlife agencies, understanding hunter perceptions towards CWD is critical, especially in regions where CWD has recently been detected. During the 2021–2022 deer hunting season, CWD was detected in two states in the southeastern U.S.; Alabama, where it was detected in December 2021, and Louisiana, where it was detected in February 2022 (Finley & Moore, 2022; Outdoor Alabama, 2022). To date, there is a lack of comprehensive information on hunter perceptions towards CWD in the southeast, where hunter perceptions may differ from other regions with CWD detections (Harper et al., 2015; Miller, 2003; Needham & Vaske, 2006; Vaske & Lyon, 2011; Vaske & Miller, 2018). This study addresses this knowledge gap by conducting a novel survey to assess deer hunter perceptions of CWD in Alabama and Louisiana (i.e., the Southeast). We anticipated there would be variation in perceived risk, concern, and comfort associated with CWD by southeastern deer hunters. By understanding hunter perceptions in regions with new CWD detections, agencies can better respond to deer hunter perceptions by developing tailored educational and outreach materials to best retain hunter support and combat CWD.

### ***Perceived Risk***

Perceived risk refers to an individual's belief that they were exposed to a danger or hazard, such as a wildlife disease (Vaske & Miller, 2019; Vaske & Lyon, 2011). Typically, individuals perceive greater risks when a new risk emerges, such as detection of CWD in a previously unaffected state, which may lead to changes in their behavior (Sjöberg, 2000; Vaske et al., 2004). After the detection of CWD in a state, hunters may alter their actions and behaviors

based on their perceived risk of consuming meat from infected deer. For instance, after discovery of CWD in Wisconsin in 2002 and the subsequent increase in perceived risk (Heberlein, 2004), hunting license sales the following year decreased by approximately 11%, resulting in an estimated loss of \$3.4 million for the state wildlife agency (Bishop, 2004; Heberlein, 2004). Additionally, a survey of gun hunters in Wisconsin in 2001 determined that half of those who did not participate in deer hunting the year after CWD was detected chose not to participate due to perceived risk towards the disease (Vaske et al., 2004).

### ***Concern***

Hunter concern refers to an individual feeling worried about the prevalence rate of CWD and the potential impacts of CWD on human health. With a statewide prevalence rate as low as three percent, 13% of hunters in Arizona, North Dakota, South Dakota, and Wisconsin stated that they would stop deer hunting, expressing that they were concerned about CWD (Vaske & Lyon, 2011). As the prevalence rate of CWD hypothetically increased to 50%, hunter concern drastically increased, with 52% of hunters stating that they would stop deer hunting (Vaske & Lyon, 2011). Deer hunters across the U.S. have expressed high levels of concern about the potential health implications that could occur from eating a CWD positive deer (Brown et al., 2006; Vaske & Lyon, 2011), even though there is currently no evidence that CWD can infect humans (Centers for Disease Control and Prevention, 2019). If CWD hypothetically caused a death in humans, 43% of hunters from Arizona, North Dakota, South Dakota, and Wisconsin indicated that they would stop deer hunting (Vaske & Lyon, 2011). Recent studies have reported that hunters express a similar level of concern that CWD could affect both their health and that of their family (Rubino & Serenari, 2023).

### ***Comfort Level***

Comfort level refers to whether a hunter will continue to hunt regardless of CWD being detected and is dependent upon an individual's risk tolerance (Brown, 2008; Hanisch-Kirkbride et al., 2013). Studies have previously identified that hunters who are comfortable with continuing to hunt in regions where CWD has been detected demonstrate greater risk tolerance (Hanisch-Kirkbride et al., 2013; Vaske & Lyon, 2011). As individuals gain experience with risky situations, their comfort zone expands, leading to a gradual reduction in perceived risk over time (Brown, 2008). Consequently, hunters who have accumulated more experience with CWD may become more comfortable with CWD due to repeated exposure to the disease.

## **Methods**

### ***Online Survey Development***

An online survey was conducted to collect data from white-tailed deer hunters (hereafter referred to as hunters) who participated in the October 2021–February 2022 deer hunting season in Alabama or the September 2021–February 2022 deer hunting season in Louisiana (Figure 1). The survey consisted of 40 questions, including multiple choice, short answer, and Likert scale questions, and were identical for each state, apart from state-specific questions (Appendix A and Appendix B). For example, questions regarding knowledge of CWD were tailored to reflect state-specific regulations. Hunters were also asked about their demographics, hunting history (e.g., average number of deer harvested annually, hunting motivations (Decker et al., 2012), and in which areas they hunted), and their perceived risks, concerns, and comfort associated with CWD. The survey was distributed through Qualtrics software, Version January 2022, via a URL link.

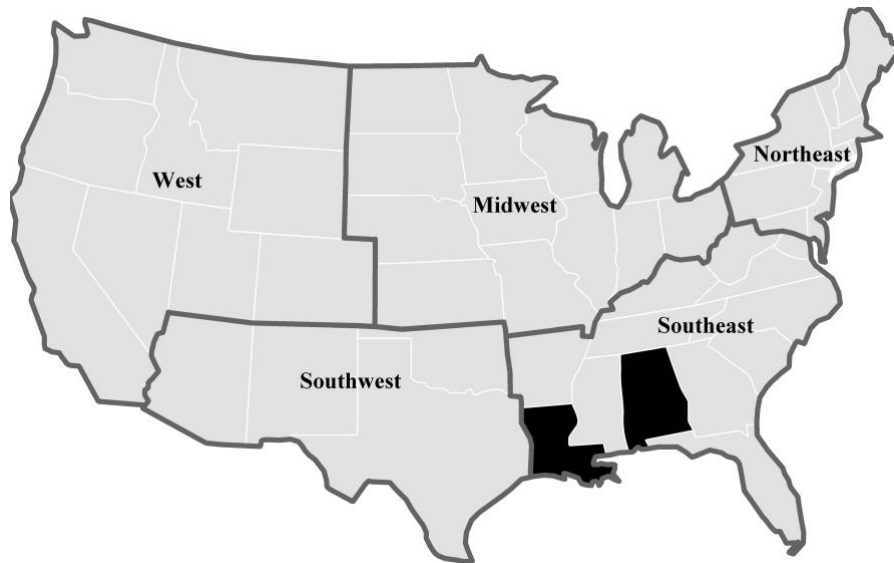


Figure 1. Geographical representation of continental United States (U.S.) regions and study states. The study states, Alabama and Louisiana, are shaded in black within the southeastern region. Other U.S. regions are identified with text labels and have a dark grey border.

Because the research was designed to assess perceptions of hunters following first detection of CWD in a state, we targeted respondents using methodologies that we believed would be the fastest. We obtained an opportunistic sample by targeting Alabama and Louisiana hunters through online hunting forums (e.g., ALdeer.com, TigerDroppings.com, and relevant Facebook groups). Additionally, we reached out to two organizations, National Deer Association and Deer & Deer Hunting, who sent an email with the URL link to the survey to their Alabama and Louisiana email listservs. Non-resident deer hunters were excluded from the email listservs from National Deer Association and Deer & Deer Hunting. Eligibility criteria required respondents to be adults ( $\geq 19$  years old) who had a deer hunting license or hunted deer in either Alabama or Louisiana during the 2021–2022 deer hunting season. All responses were anonymous and no identifying information was collected. The study was approved by the Auburn University Institutional Review Board under protocols #22-013 EX 2201 and #22-048 EX 2202.



To mitigate potential biases, measures were taken to prevent multiple submissions from the same participant (Dillman et al., 2010; Vaske, 2008). The Qualtrics software was set to “prevent multiple submissions” by placing a cookie in participants’ web browsers upon survey submission, ensuring they could not take the survey more than once (Qualtrics, Provo, UT). Additionally, the URL link to the survey was posted in each hunting forum one time. The Alabama survey was distributed two weeks after announcement of detection of CWD in a wild white-tailed deer in Lauderdale County, Alabama on January 21, 2022. Similarly, the Louisiana survey was distributed four days after announcement of detection of CWD in a wild white-tailed deer in Tensas Parish, Louisiana on February 8, 2022. Both surveys remained active for four weeks.

We determined the minimum sample size required to be able to generalize our results to the hunter population in each state according to Dillman (2007). Considering the deer hunter population sizes of Alabama (N = 237,878; Duda et al., 2022) and Louisiana (N = 208,200; Louisiana Department of Wildlife and Fisheries, 2022), we determined that a sample size of 384 individuals was sufficient to generalize our results to the hunting population of each state at a 95% confidence level with a  $\pm 5\%$  margin of error (Dillman, 2007; Vaske, 2008).

### ***Statistical Analyses***

We completed all of our statistical analyses in R version 4.2.1 (R Core Team, 2022). We began by using a two sample t-test to compare the means of continuous variables (i.e., age and number of deer harvested) to determine if there were differences between Alabama and Louisiana hunters. Additionally, we used a proportion of differences test with our binary variables to determine if there were differences between Alabama and Louisiana hunters. For each state, four global logistic regression models were developed to identify factors that influence the level of

perceived risk, concern, and comfort associated with CWD. Each model was run separately for Alabama and Louisiana to explore potential differences among hunters in these states. Global models with 20 independent variables were used to ensure consistent predictor variables across each model. Hypotheses for each independent variable were developed based on existing literature. If a hypothesis was not able to be developed for independent variables, we assumed there were no significant differences between the groups (i.e., null hypothesis). Statistical significance was determined using  $\alpha = 0.10$ . Collinearity in the data was assessed using variance inflation factors (VIFs); no collinearity was detected. Logistic regressions were conducted independently for each state and the goodness of fit was evaluated using McFadden's pseudo-R-squared.

## **Results**

Across all distribution channels, 753 responses were received from Alabama hunters and 751 responses were received from Louisiana hunters, with 689 responses from Alabama and 682 responses from Louisiana meeting eligibility criteria. Demographics of hunters in Alabama and Louisiana were similar, as over 80% of respondents identified as white, male, and had a household income less than \$70,000 in 2019 (Table 1). Mean age of hunters in Alabama ( $M + SD$ ; 50.26 + 13.43) and Louisiana (50.11 + 13.84) were similar ( $p = 0.889$ ). Louisiana had a slightly greater ( $p = 0.004$ ) proportion of hunters that identified as Latino or Hispanic than Alabama. Most hunters who participated in our survey had a college education, although a slightly greater ( $p = 0.015$ ) proportion of Alabama hunters had a college education than Louisiana hunters. Although over 80% of hunters in both states exclusively used private land to hunt deer, a greater ( $p = 0.001$ ) proportion of Alabama hunters exclusively used private land to

hunt deer than Louisiana hunters. Lastly, Alabama hunters harvested a greater ( $p = 0.002$ ) number of deer in the 2021–2022 deer hunting season than Louisiana hunters.

**Table 1. Descriptive statistics of Alabama and Louisiana hunters.**

Variable Names	Alabama		Louisiana		P	Test Statistic
	n	%	n	%		
<b>Demographics</b>						
Gender (Male)	635	96.69	600	96.83	0.889	0.02
Age (Years)	689	$M = 50.26$	682	$M = 50.11$	0.836	-0.21
Race (White)	625	97.44	580	96.72	0.460	0.55
Latino/Hispanic (Yes)	601	0.17	549	1.82	0.004	8.30
College Educated (Yes)	639	82.00	597	76.48	0.015	5.94
Household Income Above U.S. Median (Yes)	627	82.29	582	79.72	0.254	1.30
<b>Hunter History</b>						
Number of Deer Harvested	625	$M = 2.26$	574	$M = 1.91$	0.002	3.06
Land Exclusively Used (Private)	424	89.62	454	81.94	0.001	10.53
Voluntary CWD Testing Before (Yes)	629	10.81	583	14.41	0.059	3.57
Knowledgeable about CWD (Less Knowledgeable)	629	74.24	582	52.58	<0.001	61.47
<b>Hunting Motivations</b>						
Experience Nature (Less Motivated)	629	13.67	580	13.28	0.840	0.04
Challenge of the Hunt (Less Motivated)	626	40.26	576	33.69	0.018	5.56
Solitude (Less Motivated)	625	33.60	574	35.89	0.406	0.69
Trophy (Less Motivated)	630	60.00	574	70.21	<0.001	13.74
Venison (Less Motivated)	628	41.88	576	33.16	0.002	9.72
Manage Deer Populations (Less Motivated)	630	38.41	577	29.64	0.001	10.31
Social Interactions (Less Motivated)	628	66.08	575	51.83	<0.001	25.27
<b>Proximity to CWD Detection</b>						
Hunts in High Risk Zone <sup>1</sup> (Yes)	639	3.91	580	21.21	<0.001	83.64
Hunts in CWD Zone (Yes)	639	6.89	580	29.83	<0.001	109.36
Lives in High Risk Zone (Yes)	639	2.97	599	2.00	0.275	1.19
Lives in CWD Zone (Yes)	639	4.23	599	7.85	0.015	5.87
<b>Hunter Perceptions</b>						
Stop Hunting Due to Detection of CWD (Yes)	599	6.34	536	4.48	0.167	1.91
Concern about Prevalence Rate (Less Concerned)	601	42.76	541	51.02	0.035	4.44
Concern about Human Health (Less Concerned)	598	75.08	538	78.25	0.208	1.59
Comfortable Hunting (Less Comfortable)	604	60.76	547	45.89	0.001	25.54

We found that a greater proportion of Alabama hunters were motivated to trophy hunt ( $p < 0.001$ ) than Louisiana hunters (Table 1). We found that a greater proportion of Louisiana hunters were motivated to hunt for the challenge of the hunt ( $p = 0.018$ ), by venison ( $p = 0.002$ ), to manage deer populations ( $p=0.001$ ), and for social interactions with other hunters ( $p < 0.001$ )

than Alabama hunters. Additionally, a greater proportion of Louisiana hunters had previously participated in voluntary CWD sampling ( $p = 0.059$ ) and were more knowledgeable about CWD ( $p < 0.001$ ) than Alabama hunters. Lastly, a greater proportion of Louisiana hunters hunted within the CWD Zone ( $p < 0.001$ ) and CWD High Risk Zone ( $p < 0.001$ ) compared to Alabama hunters.

A greater ( $p = 0.035$ ; Table 1) proportion of Alabama hunters were concerned about the prevalence rate of CWD than Louisiana hunters, while a greater ( $p < 0.001$ ) proportion of Louisiana hunters were comfortable hunting in regions where CWD has been detected than Alabama hunters.

### ***Perceived Risk to Stop Hunting***

In Alabama, hunters who were motivated to manage deer populations were 3.30 times more likely ( $p = 0.091$ ; Table 2) and those who were motivated for social interactions with other hunters were 2.41 times more likely ( $p = 0.095$ ) to stop hunting due to detection of CWD in the state. In Louisiana, male hunters were 0.12 times more likely ( $p = 0.009$ ), those with a college degree were 0.20 times more likely ( $p = 0.016$ ), those motivated for the challenge of the hunt were 0.27 times more likely ( $p = 0.037$ ), those who reside in the High Risk Zone were 31.66 times more likely ( $p = 0.048$ ), and those who reside in the CWD Zone were 16.56 times more likely ( $p = 0.086$ ) to stop hunting due to the detection of CWD in the state.

Table 2. Logistic regression estimates for models of factors explaining hunters' level of perceived risk, concern, and comfort hunting associated with CWD in Alabama and Louisiana

	Stop Hunting		Concern about Prevalence Rate				Concern about Human Health				Comfort Hunting					
	Alabama		Louisiana		Alabama		Louisiana		Alabama		Louisiana		Alabama		Louisiana	
	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE
Age	0.10	0.20	-0.01	0.02	0.30***	0.01	0.02*	0.01	0.02*	0.01	-0.01	0.01	-0.03***	0.01	-0.20**	0.01
Race	16.99	1652.00	0.47	1.22	-0.31	0.73	0.45	0.47	0.46	0.84	0.79	0.66	-0.45	0.66	-0.17	0.46
Gender	15.97	2255.00	-2.14***	0.82	0.48	0.76	0.51	0.62	-0.02	0.88	-0.37	0.68	0.60	0.78	0.43	0.57
Education	1.29	1.12	-1.62**	0.67	0.75*	0.33	-0.13	0.28	0.44	0.39	-0.30	0.33	-0.01	0.33	0.28	0.28
Income	-0.95	0.69	0.14	0.77	-0.47	0.34	0.00	0.28	-0.14	0.39	-0.11	0.34	0.03	0.33	-0.02	0.28
Number Deer Harvested	-0.05	0.15	-0.05	0.19	0.40	0.06	-0.12*	0.07	0.01	0.06	-0.08	0.09	0.00	0.05	0.03	0.07
Type of Land	-0.30	0.92	-0.01	0.91	0.21	0.40	0.11	0.31	0.09	0.52	0.45	0.41	-0.73*	0.40	0.18	0.30
Experience Nature	0.08	0.88	0.76	1.02	0.02	0.35	0.66*	0.39	-0.62	0.39	1.10*	0.59	-0.31	0.35	-0.42	0.39
Challenge of Hunt	-0.56	0.58	-1.31**	0.63	-0.12	0.25	-0.10	0.25	-0.25	0.29	0.45	0.31	-0.03	0.25	0.13	0.25
Manage Deer Populations	1.19*	0.71	-0.29	0.66	0.30	0.25	0.20	0.26	-0.23	0.29	-0.21	0.32	0.10	0.25	0.10	0.26
Social Interactions	0.88*	0.52	-0.15	0.62	-0.41*	0.24	0.36	0.23	0.39	0.27	0.38	0.28	0.19	0.24	-0.08	0.22
Venison	-0.43	0.56	-0.37	0.69	0.36	0.24	-0.20	0.25	0.65*	0.28	0.17	0.31	0.27	0.24	0.01	0.25
Solitude	0.62	0.64	-0.29	0.62	0.17	0.25	-0.15	0.25	0.42	0.30	-0.14	0.31	-0.11	0.25	0.19	0.25
Trophy	-0.60	0.56	0.04	0.76	0.23	0.23	-0.25	0.26	0.13	0.27	-0.38	0.35	-0.12	0.23	0.04	0.26
Voluntary Testing	-0.94	1.15	-0.21	0.94	-0.60	0.36	0.39	0.31	0.41	0.40	-0.14	0.31	-0.05	0.36	0.00	0.31
Knowledgeable	-0.55	0.65	0.70	0.63	-0.32	0.26	-0.39*	0.23	-0.51	0.32	-0.36	0.28	0.21	0.26	-0.03	0.22
Hunt High Risk	-0.05	1.74	-2.44	1.67	1.15	1.18	-0.15	0.43	16.36	700.26	-0.25	0.63	-3.69**	1.51	-0.11	0.45
Hunt Zone	-15.56	2013.00	-1.57	1.55	1.07	0.99	-0.04	0.40	-15.52	700.26	-0.94	0.58	0.61	0.90	0.75*	0.41
Live High Risk	0.37	1.69	3.46**	1.75	0.26	1.22	0.81	0.97	-0.93	1.57	0.53	1.07	2.66*	1.39	0.42	0.97
Live Zone	17.83	2013.00	2.81*	1.63	-2.75**	1.31	0.13	0.49	-0.12	2.00	0.49	0.69	1.55	1.38	0.08	0.51
Pseudo R <sup>2</sup>	0.17		0.23		0.07		524.72		0.07		0.09		0.07		0.04	
AIC	165.61		142.61		508.74		389.31		413.26		389.31		509.13		530.75	

Note: Significance notes as \*p<0.10, \*\*p<0.05, \*\*\*p<0.01. Odds ratios can be calculated by exponentiating the beta. All variables are binary except for age and number of deer harvested.

### *Concern About Prevalence Rate*

We found that for every one-year increase in hunter age, Alabama hunters were 1.03 times more likely (p = 0.003; Table 2) to be concerned about CWD prevalence rate. Additionally, Alabama hunters with a college degree were 2.12 times more likely (p = 0.023), those motivated for social interactions with other hunters were 0.66 times more likely (p = 0.086), and those who reside in

the CWD Zone were 0.06 times more likely ( $p = 0.035$ ) to be concerned about CWD prevalence rate. We found that for every one-year increase in hunter age and number of deer harvested, Louisiana hunters were 1.02 times more likely ( $p = 0.066$ ) and 0.89 times more likely ( $p = 0.089$ ) respectively, to be concerned about CWD prevalence rate. Additionally, Louisiana hunters that were motivated to experience nature were 1.93 times more likely ( $p = 0.089$ ) and those knowledgeable about CWD were 0.68 times more likely ( $p = 0.084$ ) to be concerned about CWD prevalence rate.

### ***Concern That CWD Could Affect Human Health***

We found that for every one-year increase in hunter age, Alabama hunters were 1.02 times more likely ( $p = 0.083$ ; Table 2) to be concerned that CWD could affect human health. Additionally, we found that Alabama hunters who were motivated by venison were 1.92 times more likely ( $p = 0.020$ ) to be concerned that CWD could affect human health. We found that Louisiana hunters who were motivated to experience nature were 3.01 times more likely ( $p = 0.063$ ) to be concerned that CWD could affect human health than those less motivated to hunt to experience nature.

### ***Comfort Level Hunting in Regions with CWD***

We found that for every one-year increase in hunter age, Alabama hunters were 0.97 times more likely ( $p = 0.001$ ; Table 2) to be comfortable hunting in regions where CWD has been detected. Additionally, we found that Alabama hunters who hunt on private land were 0.48 times more likely ( $p = 0.070$ ), who hunt in the High Risk Zone were 0.02 times more likely ( $p = 0.014$ ), and who live in the High Risk Zone were 14.36 times more likely ( $p = 0.056$ ) to be comfortable hunting in regions where CWD has been detected. We found that for every one-year increase in hunter age, Louisiana hunters were 0.82 times more likely ( $p = 0.040$ ) to be comfortable hunting

in regions where CWD has been detected. Additionally, Louisiana hunters who hunt in the CWD Zone were 2.12 times more likely ( $p = 0.068$ ) to be comfortable hunting in regions where CWD has been detected.

## **Discussion**

Our results demonstrated differences in hunter perceptions in southeastern states with recent detections of CWD, particularly in relation to general perceptions toward hunting and CWD. Consistent with previous research, which underscores regional variations in hunter perceptions of quality deer management (Stoakley et al., 2023) and CWD (Needham et al., 2004; Smith et al., 2021), our study found that there were differences in hunter perceptions about CWD. Differences in hunter perceptions were influenced by hunter history, hunting motivations, and proximity to the initial CWD detection in their state. Notably, a greater proportion of hunters in Louisiana expressed comfort in hunting in regions where CWD has been detected, where a greater proportion of hunters in Alabama expressed concern about the prevalence rate of CWD in their state. Therefore, our findings suggest that generalizing deer hunter perceptions about CWD to a region such as the southeastern U.S. may be problematic. Hunter perceptions about CWD have been shown to be influenced by their level of trust with the state wildlife agency (Harper et al., 2015; Holsman et al., 2010; Needham & Vaske, 2008; Vaske et al., 2004) and length of time that the disease has been present (Gigliotti, 2004; Meeks et al., 2022; Vaske & Miller, 2019). Generalizing perceptions of hunters about CWD to a region could lead to controversial management actions being implemented, potentially resulting in the loss of hunter retention and support (Heberlein, 2004).

Our results indicate that southeastern hunters expressed greater concern about CWD prevalence rate and potential effects on human health than midwestern hunters (Oruganti et al.,

2018). Most midwestern hunters expressed low levels of concern over wildlife disease and concern about potential effects to their health due to exposure to the disease (Oruganti et al., 2018), while we found that about half of southeastern hunters were concerned about the prevalence rate of CWD and approximately a quarter of southeastern hunters expressed greater concern about potential human health effects. These regional differences may be a result of the timing of the study relative to the first detection of CWD within the wild deer population. The Oruganti et al. (2018) study was conducted one year after the detection of CWD in a captive deer facility and five years before the detection of CWD in a wild deer population, while our study was conducted approximately one month after the detection of CWD in a wild deer. The novelty of CWD to the southeast, both in surrounding states and in our study states, may have elevated concern among hunters, similar to what has been reported in other research (Vaske et al., 2004; Vaske & Lyon, 2011).

We found that there were differences in Alabama and Louisiana hunters' comfort with hunting in regions where CWD has been detected based on where they live, indicating that hunter comfort levels are not generalizable at the initial detection of CWD within a state or region of the U.S. We found that Louisiana hunters who live within either the High Risk Zone or the CWD Zone were more likely to stop hunting due to detection of CWD, while we did not find that residence location was a significant factor for Alabama hunters. Our Louisiana findings are similar to those in Wisconsin, which found that hunters who live in CWD-positive counties perceive greater risks of CWD and may be less comfortable hunting in areas where CWD has been detected (Vaske et al., 2004). Similar to previous research in South Dakota (Gigliotti, 2004), we found that Alabama hunters that live in the CWD Zone expressed less concern about



the CWD prevalence rate than those who do not live in the CWD Zone. However, we did not find residence location to influence the level of concern among Louisiana hunters.

Our results revealed that hunters in Alabama who exclusively hunt deer on private land were less comfortable hunting in regions where CWD has been detected than hunters who exclusively hunt deer on public land. Previous research has indicated that public land hunters spend less time hunting and tend to have overall lower harvest rates than private land hunters (Duda et al., 2022; Stedman et al., 2008). Additionally, previous research (Gore et al., 2009) reported that hunters are less likely to alter their behavior, such as stopping hunting in regions where CWD has been detected, if they perceive lower risk of exposure to wildlife diseases.

It is important to note that our sample of hunters may not be entirely representative of the broader hunting population in each state because of the methods employed to ensure rapid distribution of our survey. We recognize that our methods excluded hunters under the age of 19, those lacking internet access, and those who do not utilize online hunting forums. However, the composition of our Alabama and Louisiana deer hunter samples, in terms of gender and average age, were consistent with deer hunter demographics from the 2021–2022 hunting season reported by the state wildlife agencies (Duda et al., 2022; Louisiana Department of Wildlife and Fisheries, 2022). We acknowledge that a critical stakeholder group, non-resident deer hunters, were underrepresented through our sampling methods. Non-resident hunters play a critical role in CWD management through both the funding they provide to states via the purchase of their hunting license and the number of deer they harvest (Vaske et al., 2022).

Understanding hunter perceptions after the initial detection of CWD in an area is essential for state wildlife agencies to comprehend hunter behavior and further advance wildlife disease management. Our findings underscore that despite Alabama and Louisiana detecting

CWD within a few weeks of one another, there exist notable variations in the level of concern and comfort that hunters perceive towards CWD. Variations in hunter perception were influenced by hunter history, hunting motivations, and proximity to the CWD detection. Thus, understanding hunter perceptions can guide state wildlife agencies to tailor educational materials towards individuals who are more concerned or perceive greater risks regarding CWD. Although our study addressed states with recent detections of CWD, our findings hold broader implications for wildlife agencies, highlighting a need to assess stakeholder perceptions following the initial detection of a wildlife disease.

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## **Chapter 2. Chronic wasting disease: A comparative policy analysis in the United States**

Keywords: chronic wasting disease, CWD, deer management, wildlife disease management

### **Abstract**

We present an analysis of 28 chronic wasting disease (CWD) management plans from affected states within the United States. We used policies recommended by the Association of Fish and Wildlife Agencies Technical Report on *Best Management Practices for the Prevention, Surveillance, and Management of CWD* to determine the potential impact of policy implementation on disease prevalence. Our linear mixed models revealed that states with a written CWD management plan that banned baiting and banned natural cervid urine lures, either statewide or within the CWD zone, exhibited lower prevalence. Additionally, we found that states that had special CWD hunting opportunities and banned rehabilitation of cervids within their established CWD zones had greater prevalence. Our findings highlight the necessity for a multifaceted approach to CWD management, where state wildlife agencies implement both prevention and management policies to effectively combat CWD within their boundaries.

## Introduction

Chronic wasting disease (CWD) is a fatal neurodegenerative disease that affects members of the Cervidae family, hereafter referred to as cervids, including game species such as white-tailed deer (*Odocoileus virginianus*), mule deer (*Odocoileus hemionus*), elk (*Cervus canadensis*), and moose (*Alces alces*) (Richards, 2024). CWD is transmitted via prions (i.e., abnormal proteins) that spread throughout a cervid's body, ultimately affecting the lymphatic and central nervous systems (Centers for Disease Control and Prevention, 2019). Both clinical and non-clinical infected cervids shed prions through the excretion of infectious materials including urine, feces, blood, and saliva (United States Geological Survey, 2019). CWD spreads to healthy cervids through direct contact with infected individuals or indirectly via prions in the soil or contaminated food sources (Centers for Disease Control and Prevention, 2019; Rivera et al., 2019). As of 2024, CWD has been detected in 33 states within the United States (U.S.), and globally in Canada, Finland, Norway, South Korea, and Sweden (Richards, 2024). CWD poses a management challenge as the disease can negatively impact cervid population densities and could also diminish a state wildlife agency's ability to control the disease due to reduced hunter participation (Bishop, 2004; DeVivo et al., 2017; Edmunds et al., 2016). To date, there are currently no preventions, treatments, or cures for CWD (Centers for Disease Control and Prevention, 2019).

State wildlife agencies in the U.S. are granted authority by their state governments to manage wildlife, leading agencies to create individualized plans combating various wildlife issues, including CWD management, within their borders (Blumm & Paulsen, 2013). This has led to many different jurisdictions and variations in CWD management, attributed to differences in available funding, cervid species present, disease prevalence, and public attitudes and opinions

(Gillin & Mawdsley, 2018). Therefore, it is important to understand the variations in policies used and which policies are effective in combatting the spread of the disease.

The spread of CWD across the U.S. presents a threat to wildlife conservation due to the expense of current state wildlife agency CWD management plans. In Fiscal Year 2021, state wildlife agencies in affected states spent between \$64,435 and \$2.1 million managing the disease (Thompson & Mason, 2022). Funding for state wildlife agencies comes directly through the purchase of hunting licenses or indirectly through the Federal Aid in Wildlife Restoration Act, commonly known as the Pittman-Robertson Act of 1937. The Pittman-Robertson Act distributes revenue from an 11% excise tax on hunting equipment and ammunition to state wildlife agencies based on an equation that considers land mass size and number of hunting licenses sold annually (Crafton, 2019; Duda et al., 1998; Voyles & Chase, 2017). If hunters are concerned about CWD, including its potential effects on human health, hunting license sales and thus funding for state wildlife agencies could potentially be reduced. For instance, 11% of those who hunted in Wisconsin in 2002 did not purchase a hunting license the year after CWD was detected (2003) due to concerns about the disease, resulting in a loss of approximately 66,000 hunting licenses and \$33 million in hunting expenditures (Bishop, 2004). In addition to funding from hunting license sales and the Pittman-Robertson Act of 1937, federal funding has recently increased due to the passage of the CWD Research and Management Act (Brady, 2022; NDA Staff, 2022). The CWD Research and Management Act allocates \$70 million equally between CWD research and management efforts to support state and tribal wildlife agencies in combating CWD annually through Fiscal Year 2028 (Brady, 2022; NDA Staff, 2022).

Although state wildlife agencies have the autonomy to implement management decisions at the state level, it is common for states to implement recommendations created by the

Association of Fish and Wildlife Agencies (AFWA), an organization that collectively represents state, provincial, and territorial fish and wildlife agencies to advance science-based conservation and management efforts (Association of Fish & Wildlife Agencies, 2023). To assist state wildlife agencies with managing CWD in cervid populations, AFWA created a Technical Report on *Best Management Practices for Prevention, Surveillance, and Management of CWD* (hereafter referred to as AFWA's *Best Management Practices*; Gillin & Mawdsley, 2018). Multiple states in the U.S., including Arkansas, Colorado, Minnesota, and Wyoming, have implemented recommendations from AFWA's *Best Management Practices* directly into their CWD management plans (Ballard et al., 2021; Colorado Parks & Wildlife, 2018; Minnesota Department of Natural Resources, 2019; Wyoming Game and Fish Department, 2019).

AFWA's *Best Management Practices* is a framework that provides recommendations based on the best available science for state wildlife agencies to utilize in the fight against CWD (Gillin & Mawdsley, 2018). The recommendations are organized into three categories: (1) prevention, (2) surveillance, and (3) management. Prevention includes actions wildlife agencies can implement to avert introduction and establishment of CWD in their state, including actions such as banning importation of live captive cervids, banning importation of hunter-harvested carcasses from other states (i.e., interstate carcass ban), banning use of natural cervid urine as a lure for hunting, and banning hunters from baiting or feeding cervids (Gillin & Mawdsley, 2018). Surveillance includes wildlife agencies collecting and testing hunter-harvested, roadkill, or suspect cervids<sup>1</sup> in areas with no known detections of the disease, as well as in areas with known positive detections to monitor distribution and prevalence of CWD (Gillin & Mawdsley,

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<sup>1</sup> Suspected cervids are animals that display outward symptoms of a disease or illness and are reported to state wildlife agencies by stakeholders (e.g., hunters, landowners, concerned citizens). The outward symptoms may mimic known clinical symptoms of CWD.

2018). Lastly, management includes actions wildlife agencies can implement to reduce prevalence of CWD within their jurisdiction (Gillin & Mawdsley, 2018). Management actions include development of a written CWD response plan and creation of CWD zones with specific regulations such as banning baiting, banning intrastate carcass movement, implementing targeted cull<sup>2</sup> programs, increasing hunter-harvest rates, and banning rehabilitation of cervids. State wildlife agencies then select a combination of policies from these recommendations to achieve their goals (Gillin & Mawdsley, 2018).

To date, policy analyses of state-level CWD management plans have not included biological data, such as annual disease prevalence, resulting in a gap in the literature. Rather, a previous study quantified the number of CWD management and communication efforts implemented by state wildlife agencies in the U.S. prior to June 2020 (Miller & Vaske, 2022). States that had positive CWD detections were more engaged in management and communication efforts than states that had not detected CWD (Miller & Vaske, 2022). Thompson et al. (2023) further summarized CWD management actions implemented by wildlife agencies globally that had positive CWD detections prior to October 2020. Thompson et al. (2023) categorized management actions implemented by these agencies into pre-detection, initial response, and altered response categories and found that most state wildlife agencies in the U.S. used a proactive approach to manage CWD; 12 states implemented a weighted surveillance program<sup>3</sup> and 17 states had CWD-specific regulations before detection of CWD in their state.

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<sup>2</sup> Targeted culling is the removal of cervids from populations that most likely have CWD or are in a known CWD hotspot area by individuals hired by the state wildlife agency (Colorado Parks & Wildlife, 2018).

<sup>3</sup> A weighted surveillance program is a surveillance system that allocates more sampling resources to factors assigned higher weights, where weights are determined by CWD risk factors; risk factors can include demographic factors or spatial risk (Thompson et al., 2023; Walsh & Miller, 2010).

While the effectiveness of most management actions used by state wildlife agencies to combat CWD remains undocumented, two intensive management actions have been examined to determine their effectiveness (Conner et al., 2021; Uehlinger et al., 2016; Wolfe et al., 2018). Predictive modeling has shown that selective removal (i.e., targeted cull) of potentially infected cervids or individuals with a greater likelihood of infection (e.g., males) can lead to a decline in prevalence (Uehlinger et al., 2016). Additionally, field studies in Illinois and Colorado indicated that intensive targeted culls were effective at reducing CWD prevalence in localized populations (Uehlinger et al., 2016; Wolfe et al., 2018). State wildlife agencies may use hunters to increase the number of cervids harvested to attempt to reduce CWD prevalence. For instance, when the harvest of male mule deer was sufficient and sustained over a period of time in the Western U.S., CWD prevalence was reduced in areas where the disease was not endemic (Conner et al., 2021). The effectiveness of intensive management actions depended on the duration that the disease was present on the landscape and the prevalence at the time of implementation (Conner et al., 2021; Uehlinger et al., 2016; Wolfe et al., 2018).

To address gaps in the literature on the relationship between CWD policies and disease prevalence, our research aims to conduct an analysis of CWD management actions implemented by state wildlife agencies in the U.S. that had detected CWD in free-ranging cervid populations before May 2022. Our first objective was to add to the existing literature on the analysis of CWD management plans in the U.S. (Thompson et al., 2023) by adding nine states that had detected CWD in free-ranging cervids to our analysis. Our second objective was to quantify the length of time that each policy response was implemented by state wildlife agencies during our 10 years of interest. Our final objective was to explore how policy responses may influence annual CWD prevalence in affected states. The results of this research may help inform state wildlife agencies

on implementing scientifically sound management actions to combat CWD and further contribute to the field of wildlife disease management.

## **Methods**

We examined the relationship between CWD policy responses of state wildlife agencies and annual CWD prevalence in states within the U.S. that had detected CWD in their free-ranging cervid (hereafter referred to as cervids) populations before May 2022 ( $n = 29$ ). We collected data between January 2021 and June 2023 for our 10-year period of interest of late 2012 to early 2022, where we used annual cervid hunting seasons as each year delineation. We used 10 years as our period of interest based on timeframes used in previous studies that aimed to determine the effectiveness of intensive control strategies such as targeted culls (Conner et al., 2007; Uehlinger et al., 2016; Wolfe et al., 2018). Moreover, we selected the 2012 to 2013 season as the starting year for data collection because real-time quaking-induced conservation (RT-QuIC), a highly sensitive method for detecting CWD prions, was first used in CWD diagnostic testing in 2013 (Haley & Richt, 2017). The specificity of RT-QuIC testing allowed state wildlife agencies to reduce the number of false negative CWD tests that would artificially inflate prevalence (Conner et al., 2007). We excluded New York from our analyses since CWD had not been detected in New York's cervid population after 2005, and therefore, it was not present in the state during our 10 years of interest (New York State Department of Environmental Conservation, n.d.).

We collected data by conducting a review of CWD management plans from state wildlife agencies. Written management plans were available for 26 of the 28 states. Additionally, we gathered data from state wildlife agency websites in the CWD or wildlife disease section. All 28 states had information about CWD accessible on their website. Finally, for information not found

in CWD management plans or on state wildlife agency websites, we contacted state wildlife agency experts (i.e., state deer biologists, wildlife health specialists, and state wildlife veterinarians) through email and by phone. All but one of the state wildlife agency experts (27 out of 28) that we contacted responded with the information we requested.

We aimed to determine whether state-level CWD policies have an influence on annual CWD prevalence in affected states. Our dependent variable was annual prevalence of CWD in each of the 28 affected states during our 10 years of interest. We calculated CWD prevalence as the proportion of the cervid population that tested positive for CWD, which we expressed as a percentage. To account for differences in the scale of CWD prevalence that state wildlife agencies provided to us, we categorized each state's prevalence into one of three groups: (1) CWD-positive county (i.e., one affected county), (2) CWD-positive area (i.e., multiple affected counties), or (3) state (i.e., all counties).

Our independent variables were CWD policy responses, and to make sure they were relevant to decision-makers for interpretation and application in management decisions, we used AFWA's *Best Management Practices* to select policy responses. We treated baiting, supplemental feeding, and mineral attractant bans as three distinct variables. We made this decision because some states, while banning baiting, still permit supplemental feeding or the use of mineral attractants, or vice versa. We then categorized each policy response into one of AFWA's three categories: prevention, surveillance, or management (Table 1; Gillin & Mawdsley, 2018). Following our initial classification into one of AFWA's three categories, we assigned a binary value to each policy response to indicate implementation status (i.e., 0 for 'not implemented' and 1 for 'implemented') for each year within the 10 years of interest. When coding policy responses specific to CWD zones (e.g., bait ban in the CWD zone), we limited



inclusion to states with an established CWD zone that did not have existing statewide regulations (e.g., statewide bait ban). This approach allowed us to determine the potential influence of zone-specific regulations on CWD prevalence. Additionally, we summarized the length of time that states had implemented policy responses on an interval scale, ranging from zero to 10 years, to determine the most used policy responses by state wildlife agencies (Table 2).

Table 1. Definitions of CWD prevention, surveillance, and management actions.

Theme	Policy Actions	Definitions
Prevention	Statewide Carcass Transport Ban	Interstate restriction of whole cervid carcasses or bone-in meat from out-of-state to in-state
	Statewide Ban on Live Cervid Transport	Prohibits the importation of live cervids into the state
	Statewide Natural Cervid Urine Ban	Prohibits the use of natural cervid urine to aid with hunting statewide
	Statewide Bait Ban	Prohibits the use of food lures (e.g., corn) to aid with hunting statewide
	Statewide Supplemental Feeding Ban	Prohibits the placement of food by humans to increase the availability of food for wildlife statewide
	Statewide Mineral Attractant Ban	Prohibits the placement of minerals to aid in nutritional support for wildlife statewide
Surveillance	CWD Testing	Active CWD testing done by the state wildlife agency for CWD surveillance
	Mandatory CWD Testing	CWD testing is mandated by the state wildlife agency in areas of the state that have detected CWD
Management	Written CWD Plan	Written and published CWD management plan for the state wildlife agency
	Target Cull	Intentional removal of cervids from the population by people hired by the state wildlife agency
	Special CWD Hunting Opportunity	Additional hunting opportunities outside of the regular season that are established by state wildlife agencies for hunters to harvest cervids in areas where CWD has been detected
	CWD Zone	Geographic region where CWD has been detected (in either free-ranging or captive cervids) where site-specific regulations can be implemented or a CWD surveillance zone before detecting the disease
	Bait Ban in CWD Zone	Prohibits the use of food lures (e.g., corn) to aid with hunting in an established CWD zone
	Supplemental Feed Ban in CWD Zone	Prohibits the placement of food by humans to increase the availability of food for wildlife in an established CWD zone
	Mineral Attractant Ban in CWD Zone	Prohibits the placement of minerals to aid in nutritional support for wildlife in an established CWD zone
	Natural Cervid Urine Ban in CWD Zone	Prohibits the use of natural cervid urine to aid with hunting in an established CWD zone
	Bag Limit Increase in CWD Zone	Increases the number of deer that hunters can harvest in an established CWD zone
	Antler Point Restrictions Lifted in CWD Zone	Removes antler point restrictions for hunters in an established CWD Zone
	Carcass Movement Ban Outside CWD Zone	Intrastate restriction of whole cervid carcasses or bone-in meat from in CWD zone to out of CWD zone
	Rehabilitation Ban in CWD Zone	Prohibits the rehabilitation of cervids in an established CWD zone

Note. Policy action definitions were created by the authors using previous definitions from Colorado Parks & Wildlife (2018) and Gillin and Mawdsley (2018).

Table 2. Proportion of states that have implemented a CWD policy for a given length of time between the 2012-2013 and 2021-2022 deer hunting seasons.

AFWA's Best Management Practices	Policy Response	Proportion of States											n
		0 Years	1 Year	2 Years	3 Years	4 Years	5 Years	6 Years	7 Years	8 Years	9 Years	10 Years	
Prevention	Interstate Carcass Transport Ban	0.14		0.04			0.07	0.04	0.11	0.04		0.57	28
	Statewide Ban on Live Cervid Transport	0.89			0.04							0.07	28
	Statewide Natural Cervid Urine Ban	0.71		0.04	0.07	0.04	0.04	0.04		0.04		0.04	28
	Statewide Bait Ban	0.48			0.04				0.04	0.04		0.41	27
	Statewide Supplemental Feeding Ban	0.78				0.04			0.04			0.15	27
	Statewide Mineral Attractant Ban	0.81				0.04			0.04			0.12	27
	CWD Zone	0.29	0.14			0.07	0.04		0.07	0.04		0.36	28
Management	Written CWD Plan	0.07				0.04	0.04	0.04	0.04	0.04		0.75	28
	Target Cull	0.69	0.07	0.07	0.07		0.04					0.07	28
	Special CWD Hunting Opportunity	0.53	0.14		0.04		0.07	0.07			0.04	0.11	28
	CWD Zone	0.29	0.14			0.07	0.04		0.07	0.04		0.36	28
	Bait Ban	0.30	0.30			0.10		0.10				0.20	10
	Supplemental Feeding Ban	0.23	0.12			0.17	0.06		0.06	0.06		0.34	18
	Mineral Attractant Ban	0.28	0.12			0.17	0.06		0.06	0.06		0.28	18
	Natural Cervid Urine Ban	0.77							0.08			0.08	13
	Bag Limit Increase	0.70	0.05		0.05		0.10					0.10	20
	Antler Point Restrictions Lifted	0.75	0.05			0.10	0.50					0.05	20
Surveillance	Intrastate Carcass Movement Ban	0.10	0.20		0.05	0.10	0.05		0.10	0.05		0.35	20
	Cervid Rehabilitation Ban	0.79	0.05			0.05		0.05				0.05	19
	CWD Testing											1.00	28
	Mandatory CWD Testing	0.35	0.19		0.12	0.04	0.04		0.04			0.23	26

Note: Totals may not add up to 1.00 due to rounding. Policy responses that are indented in from CWD zone are zone-specific regulations and include only states that have established CWD zones. Blank cells indicate values of 0.00, signifying that no states implemented the policy during the specified length of time

To better understand how policy responses influence prevalence, we fit two linear mixed models with a logit function to our data. We included policy responses that fell into the management and prevention categories as our fixed effects. We ultimately excluded policies that fell into the surveillance category, as surveillance is used to evaluate effectiveness of policies or interventions, monitor prevalence of the disease, and track geographic spread of the disease (Chow & Leo, 2017; Williams et al., 2002).

Our first model predicted the impact of CWD management and prevention strategies on CWD prevalence in 28 affected states. The variable of a statewide mineral attractant ban was removed from the first model as it was not mutually exclusive from a supplemental feeding ban. CWD zone-specific regulations (e.g., bait ban in the CWD zone) were excluded from the first model, given their dependence on the establishment of a CWD zone. Our second model predicted the impact of CWD zone-specific regulations on CWD prevalence in the 20 states that had an established CWD zone during our period of interest. To prevent any issues with collinearity, we excluded the variables of supplemental feeding ban in the CWD zone and mineral attract ban in the CWD zone from the second linear mixed model. Additionally, during the model-fitting process, we identified that inclusion of the variable of antler point restrictions did not contribute independent information to the model due to insufficient variability in the data, thus the inclusion of the variable would compromise the reliability and interpretability of the model (James et al., 2023).

In both models, state was treated as a random effect to account for unobserved heterogeneity across states. The scale of CWD prevalence, which was provided by state wildlife agencies, was also included as a random factor in both models to address variability. CWD prevalence was logit transformed to meet the assumption of normality for the response variable.

To assess collinearity, we calculated variance inflation factors (VIFs) and ensured that values for all variables included in our models were less than 2.00. The linear mixed models were estimated using the 'lme4' package in R version 4.2.1 (R Core Team, 2022). To evaluate the statistical significance of the observed effects, we set  $\alpha = 0.10$ .

## **Results**

The duration that state wildlife agencies implemented prevention, surveillance, and management policies varied (Table 2). The most common prevention policies that were implemented for at least one year during our period of interest were an interstate carcass transport ban (86%), an established CWD zone (71%), and a statewide baiting ban (52%). All the states conducted CWD testing as a method of surveillance (100%), but only 65% of states required mandatory sampling of hunter harvested cervids for at least one year in areas that had detected CWD during our period of interest. The most common management policies that were implemented for at least one year during our period of interest included having a written CWD management plan (93%), establishment of a CWD zone (71%), and providing special CWD hunting opportunities (47%). For states with an established CWD zone, the most common management policies that were implemented for at least one year during our period of interest included having a written CWD plan (93%), an intrastate carcass transport ban (90%), a supplemental feeding ban within the CWD zone (77%), a mineral attractant ban within the CWD zone (72%), an established CWD zone (71%), and a baiting ban within the CWD zone (70%).

### ***Linear Mixed Model***

We found that four state wildlife policy responses had an impact on the annual CWD prevalence across our sample (Table 3). The presence of a written CWD management plan was associated with a 0.72% decrease in annual CWD prevalence ( $p = 0.076$ ). Additionally, the presence of a

statewide natural cervid urine ban was associated with a 0.71% decrease in annual CWD prevalence ( $p = 0.089$ ). We found that the presence of a statewide baiting ban was associated with a 1.16% decrease in annual CWD prevalence ( $p = 0.058$ ). Lastly, the presence of a special CWD hunting opportunity was associated with a 0.53% increase in annual CWD prevalence ( $p = 0.073$ ).

Table 3. Linear mixed model summarizes predicting impact of CWD management and prevention strategies on CWD prevalence in 28 states in the United States between the 2012-2013 and 2021-2022 deer hunting seasons.

Fixed Effect	$\beta$	95% Confidence Limits		$p$
		0.025	0.975	
CWD Plan (M)	-0.72	-1.48	0.06	0.076*
Target Cull (M)	-0.27	-1.15	0.50	0.521
Special CWD Hunting Opportunity (M)	0.53	-0.02	1.12	0.073*
CWD Zone (M)	0.35	-0.45	1.09	0.390
Statewide Carcass Transport Ban (P)	0.04	-0.57	0.61	0.906
Statewide Natural Cervid Urine Ban (P)	-0.71	-1.53	0.03	0.089*
Statewide Bait Ban (P)	-1.16	-2.21	-0.09	0.058*
Statewide Supplemental Feeding Ban (P)	0.59	-0.82	1.97	0.451

*Note.* Parentheses indicate whether a policy action is considered management (M) or prevention (P) based on AFWA’s Best Management Practices. We included random effects of state (variance = 1.14, SD = 1.07) and scale of prevalence (variance = 0.52, SD = 0.18) in the model. Significance notes as \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

In our second model, we found that three CWD zone-specific regulations had an impact on the annual CWD prevalence of states that had an established CWD zone (Table 4). The presence of a baiting ban in the CWD zone was associated with a 0.90% decrease in annual CWD prevalence ( $p = 0.024$ ). The presence of a natural cervid urine ban in the CWD zone was associated with a 3.14% decrease in annual CWD prevalence ( $p = 0.095$ ). Lastly, the presence of a cervid rehabilitation ban in the CWD zone was associated with a 1.06% increase in annual CWD prevalence ( $p = 0.052$ ).

Table 4. Linear mixed model summarizes predicting impact of CWD zone regulations on CWD prevalence in 20 states in the United States that had an established CWD zone at any point between the 2012-2013 and 2021-2022 deer hunting seasons.

Fixed Effect	$\beta$	95% Confidence Limits		<i>p</i>
		0.025	0.975	
Bait Ban Zone	-0.90	-1.52	0.09	0.024**
Natural Cervid Urine Ban Zone	-3.14	-4.96	-1.27	0.095*
Rehabilitation Ban Zone	1.06	0.04	2.08	0.052*
Bag Limit Increase Zone	0.75	-0.65	1.97	0.272
Carcass Movement Ban Zone	1.83	0.08	3.60	0.250

*Note.* All fixed effects are a subset of the policy response of establishing a CWD zone, thus only states that had an established CWD zone were used for analysis. We included random effects of state (variance = 1.14, SD = 1.07) and scale of prevalence (variance = 0.52, SD = 0.18) in the model. Significance notes as \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

## Discussion

In both linear mixed models, we observed that states that implemented a baiting ban, either statewide or within their CWD zone, exhibited lower CWD prevalence compared to states that permitted baiting. This finding suggests that reducing unnatural congregation of cervids in areas such as bait sites may reduce the prevalence of CWD. When animals congregate, direct and indirect routes of transmission for wildlife diseases become elevated (Sorensen et al., 2014), and theory suggests that reducing the congregation of animals reduces disease transmission, hence reducing disease prevalence. Baiting bans have previously proven effective in managing infectious wildlife diseases (Cosgrove et al., 2018; O’Brien et al., 2006, 2011; Rudolph et al., 2006; Sorensen et al., 2014). For example, in response to the detection of bovine tuberculosis in free-ranging white-tailed deer in Michigan, the Michigan Department of Natural Resources implemented baiting and supplemental feeding bans in affected areas to assist with the eradication of the disease (O’Brien et al., 2006, 2011; Rudolph et al., 2006). Although eradication of bovine tuberculosis in white-tailed deer was not achieved, disease prevalence were reduced by over 60% following implementation of baiting and supplemental feeding bans

(Cosgrove et al., 2018; O'Brien et al., 2006, 2011; Rudolph et al., 2006). Additionally, despite concerns raised by hunters about potential impacts on harvest success rates, surveys from the Midwest indicated that the use of bait had an insignificant effect on harvest success (Van Deelen et al., 2006). Consequently, the potential positive impacts of the use of bait to harvest deer may not outweigh the negative impacts of increased animal contact and resulting increased disease transmission at these sites (Rudolph et al., 2006). Our findings, in conjunction with current scientific evidence, highlight the potential that baiting bans may have to reduce the prevalence and distribution of CWD (Lischka et al., 2010; Rudolph et al., 2006).

Additionally, we observed that states that implemented a ban on hunters using natural cervid urine as a scent lure, either statewide or within their CWD zone, exhibited lower CWD prevalence than states that permitted hunters to use natural cervid urine. Urine lures are designed to attract deer to a specific location for hunters, potentially resulting in increased use of that location by deer. While deer visitation to a man-made urine lure site is theoretically no biologically different than visitation of deer to a naturally created rub or scrape site where urine is naturally deposited, if the man-made site is created with urine that comes from a CWD-positive deer, exposure of deer to prions becomes elevated because prions are shed in infected cervid's urine (Henderson et al., 2015; Rivera et al., 2019). Thus, the use of natural cervid urines, whether purchased or collected from a harvested deer, as a deer attractant for hunting has the potential to increase the environmental prion load at a specific location (Henderson et al., 2015; Rivera et al., 2019; Saunders et al., 2012). This potential increased concentration of infectious prions in the environment raises the risk of direct and indirect transmission due to congregation of cervids and elevation in prion load (Almberg et al., 2011; Gillin & Mawdsley, 2018). However, natural cervid urine bans may be controversial amongst hunters as many natural cervid

urine manufacturers can voluntarily participate in an industry certification process, known as the Archery Trade Association's Deer Protection Program. The Deer Protection Program ensures that cervid urine-based products exceed federal requirements to prevent the spread of CWD (Archery Trade Association, 2017). Additionally, a large majority of hunters (75%) nationwide in 2017 expressed willingness to comply with a hypothetical policy that would ban natural cervid urine, but as experience with using urine scents increased, willingness to comply with the natural cervid urine ban decreased (Song et al., 2019). Our findings suggest that natural cervid urine bans may potentially reduce the CWD prevalence by reducing the environmental contamination load and congregation of cervids (Gillin & Mawdsley, 2018; Henderson et al., 2015; Rivera et al., 2019; Saunders et al., 2012).

We observed that states with a written CWD management plan had lower CWD prevalence than states without a written management plan. State wildlife agencies with written CWD management plans create a list of predefined management actions that are applicable at various disease detection stages, such as detection in a neighboring state, captive herd detection, or detection in the cervid population (Gillin & Mawdsley, 2018; Heberlein, 2004). Having a written CWD management plan enables a state to respond promptly and transparently to disease outbreaks, therefore enhancing public trust and support (Gillin & Mawdsley, 2018; Heberlein, 2004). Without a written CWD management plan, state wildlife agencies may inadvertently implement management actions that produce undesired consequences. For example, in the 1990s CWD was considered to be a disease of western states, and most states east of the Mississippi River did not consider CWD to pose a legitimate threat to their deer herds. As a result, little to no planning occurred in Wisconsin before the detection of CWD in 2002. Wisconsin's lack of an informed and responsive CWD management plan before detecting CWD resulted in the



implementation of reactive and controversial management actions that were later discontinued due to a lack of public support and lack of success in reducing CWD prevalence (Heberlein, 2004; Holsman et al., 2010). Existing research on other emerging infectious diseases emphasizes that management actions that are promptly implemented after disease detection are effective in reducing transmission, prevalence, and spread of the disease (Grant et al., 2017; Mitchell et al., 2013).

Surprisingly, we observed that states that implemented a special CWD hunting opportunity had greater CWD prevalence than states that did not implement such opportunities. A plausible explanation for this finding is that state wildlife agencies that implement these opportunities require hunters who participate to submit CWD samples from all harvested cervids (Arkansas Game & Fish Commission, 2023; Idaho Fish and Game, 2021; Iowa Department of Natural Resources, 2022). The calculated prevalence following the implementation of special hunting opportunities may inherently be biased due to increased number of cervids being tested for CWD within a CWD impacted area via the harvest-based sampling approach (Conner et al., 2000). For example, depending upon the timing of the special CWD hunting opportunity, cervids that are more susceptible to CWD (e.g., adult males) may be more prone to hunter harvest, and thus to CWD sampling in endemic areas (Conner et al., 2000).

Additionally, we found that states that banned rehabilitation of cervids in the CWD zone had greater CWD prevalence than states that permitted rehabilitation in the CWD zone. The decision to ban rehabilitation of cervids in CWD zones was recommended by AFWA following detection of CWD in six white-tailed deer fawns in the core endemic area in Wisconsin (Chronic Wasting Disease Alliance, 2003). The primary objective of a rehabilitation ban is to mitigate the spread of CWD into new areas by stopping transportation of cervids, both clinical and non-

clinical, into unaffected areas (Gillin & Mawdsley, 2018). As rehabilitation bans are typically implemented after a state wildlife agency detects the disease, the ban may not directly influence a state's annual CWD prevalence but may help reduce the spread of the disease. Notably, wildlife rehabilitation practices generally involve movement of wildlife across county lines within a state (Gillin & Mawdsley, 2018). For instance, in the case of white-tailed deer in New York, several deer were transported, rehabilitated, and released more than 40 miles away from their initial capture point in 2012 (New York State Department of Environmental Conservation et al., 2018).

Lastly, although we found that multiple CWD zone-specific regulations influence disease prevalence, creation of a CWD zone itself did not influence CWD prevalence. Creation of a CWD zone itself does not bring about any direct regulatory or policy changes. Instead, CWD zones provide a framework for state wildlife agencies to enhance surveillance and implement specific regulations tailored to affected areas on a localized scale (Gillin & Mawdsley, 2018). Thus, creation of a CWD zone, per se, should not exert a direct influence on the CWD prevalence as states with CWD zones may enact different policy responses within their CWD zones.

Although our study did not find that other recommendations from AFWA's *Best Management Practices* influence CWD prevalence, it would be premature to conclude that AFWA's recommendations are not best management practices. The complex nature of CWD and the current lack of solutions for disease eradication make combating CWD challenging for wildlife agencies (Gillin & Mawdsley, 2018). Furthermore, our study cannot definitively determine the precise influence of AFWA's *Best Management Practices* on CWD prevalence. The combination of multiple management actions may have contributed to moderating CWD

prevalence and preventing significant increases (Belsare et al., 2021; Uehlinger et al., 2016). The sustained and long-term implementation of AFWA's *Best Management Practices* has been effective in controlling CWD in endemic areas, especially when implementation begins promptly after the initial detection of the disease (Gillin & Mawdsley, 2018).

Using AFWA's *Best Management Practices* as a framework to understand the impact of CWD prevention and management policies on annual prevalence, we identified that both prevention and management policies have an impact on disease prevalence. While prevention and management policies can be implemented by a state wildlife agency at any point before or after CWD is detected, AFWA recommends that prevention strategies be implemented before detection and management actions after detection (Gillin & Mawdsley, 2018). Prevention policies, such as statewide natural cervid urine bans and statewide baiting bans, aim to minimize the likelihood that CWD is introduced and becomes established in a state. Management policies, such as targeted culls and increases in bag limits, aim to stabilize or suppress CWD prevalence after the disease has been detected (Gillin & Mawdsley, 2018). Although we did not find that all current prevention and management policies have an influence on CWD prevalence, we assessed whether these policies impact prevalence on statewide. Some prevention and management policies may have an influence on CWD prevalence on a local scale, as seen with targeted culls (Manjerovic et al., 2014; Wolfe et al., 2018). Thus, it is important for state wildlife agencies to use a combination of prevention and management policies on both a statewide and localized scale to effectively minimize the potential introduction and establishment of CWD. Once CWD is established in a state, eradication is likely not possible, and management of the disease requires long-term commitment by hunters and state wildlife agencies (Gillin & Mawdsley, 2018).

While our research has provided insight into the relationship between CWD policy responses and biological outcomes, our data do not encompass all the complexities of CWD disease characteristics and management. The effects we identified in our linear mixed models are conditional based on the idea that other non-included explanatory variables such as habitat characteristics, soil composition, landscape composition (Evans et al., 2016; Kuznetsova et al., 2014) or human land use (Farnsworth et al., 2005), do not significantly impact the interpretation of the explanatory variables we included in our models. Additionally, our study represents a snapshot of time in the context of CWD management and does not account for how CWD policies and management have adapted over the entire period that CWD has been present on the landscape (Miller & Fischer, 2016). Despite these limitations, our study provides insight into the variation and influence of policy responses on CWD prevalence in states across the U.S. Recognizing the necessity for state-level variation in CWD policy responses due to differences in cervid species, disease prevalence, geographic distribution, available funding, public support, and political influences (Gillin & Mawdsley, 2018), our findings underscore the necessity for a multifaceted approach to CWD management, where state wildlife agencies utilize both prevention and management policies. When policy responses are tailored to the current disease status of each state's cervid population, state wildlife agencies may be able to effectively combat the prevalence and distribution of CWD within their cervid populations.

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## Appendix A: Alabama January 2022 Survey Instrument.

Please answer the following questions.

- What year were you born?
  - [Open-ended Numeric Response]
- Do you live and/or hunt in Alabama?
  - Yes
  - No
- Please indicate your race
  - American Indian or Alaskan Native
  - Asian
  - Black or African American
  - White
  - Other [fill in]
- Do you identify with Latino, Hispanic, or Spanish origin?
  - Yes
  - No
  - I prefer not to answer
- Please indicate your gender.
  - Male
  - Female
  - Other [fill in]
  - Other
- What is your zip code at your current residence? (5 digit zip code)
  - [Open-ended Numeric Response]
- What was your household income in 2019?
  - \$0-\$20,000
  - \$20,001-\$30,000
  - \$30,001-\$40,000
  - \$40,001-\$50,000
  - \$50,001-\$60,000
  - \$60,001-\$70,000
  - \$70,001-\$80,000
  - \$80,001-\$90,000
  - \$90,001-\$100,000
  - \$100,001+
- What is your highest level of education?
  - Did Not Graduate High School/No GED

- High School Graduate/No GED
  - Technical/Vocational School
  - Some College/AA or AS (2 Year Degree)
  - College Graduate/BA or BS (4 Year Degree)
- Did you have a hunting license that allows you to hunt deer for the 2021-2022 Alabama season?
    - Yes
    - No
  - How many deer do you typically harvest per season in Alabama?
    - [Open-ended Numeric Response]
  - Did you have a hunting license that allowed you to hunt deer for the 2021-2022 Alabama season?
    - Yes
    - No
  - How many deer do you typically harvest per season in Alabama?
    - [Open-ended Numeric Response]
  - What counties do you deer hunt in Alabama? Select all that apply.
    - [Dropdown List of All Alabama Counties]
  - What type of land do you deer hunt on in Alabama? Select all that apply
    - Personal Lease
    - Lease with Others
    - Public Land
    - Private Property (Personal/Family-owned/Friends)
  - How important is each deer hunting motivation to you? [Select One per Motivation from a 1-5 Likert-scale; 1 least important, 5 most important]
    - Experience Nature/View Wildlife
    - Challenge of the Hunt
    - Solitude
    - Trophy
    - Venison
    - Manage Deer Populations
    - Social Interactions/Experiences
  - How many deer have you harvested or intended to harvest in the 2021-2022 deer season?
    - [Open-ended Numeric Response]
  - Have you previously participated in voluntary CWD testing with your harvests in Alabama?
    - Yes

- No
- Did you attend the public informational meeting in Florence, Alabama regarding CWD on January 13, 2022?
  - Yes
  - No

Based on your current knowledge, are each of the following statements true or false?

- CWD has been found in free-ranging deer in Alabama.
  - True [Correct Answer]
  - False
  - Not Sure
- CWD has been found in captive deer in Alabama.
  - True
  - False [Correct Answer]
  - Not Sure
- CWD testing in Alabama is available at no cost to the hunter through the Alabama Department of Conservation and Natural Resource.
  - True [Correct Answer]
  - False
  - Not Sure
- CWD has been found in all states that border Alabama.
  - True
  - False [Correct Answer]
  - Not Sure
- Has a CWD-positive sample been found in Lauderdale, Colbert, or both counties?
  - Lauderdale [Correct Answer]
  - Colbert
  - Both
  - Neither
- How should you dispose of a deer carcass that was harvested in the High-Risk Zone in Alabama?
  - Incinerated
  - In a dumpster
  - Buried [Correct Answer]
  - Not Sure

Please answer the following questions regarding information pertaining to CWD.

- Is the information you need regarding CWD in Alabama easily accessible to you?
  - Yes
  - No



- What is your preferred source to obtain information regarding CWD in Alabama?
  - Friends/Family
  - State Wildlife Agency
  - Social Media
  - News Sources
  - I have not looked for CWD information before
  - Other (fill in)

Do you agree or disagree with the following statements?

- CWD can infect humans.
  - Agree
  - Disagree
  - I don't know
  
- CWD has been in Alabama since the 1960s but was just recently discovered.
  - Agree
  - Disagree
  - I don't know
  
- CWD is an uncommon disease in the US, so it isn't a threat.
  - Agree
  - Disagree
  - I don't know
  
- Epizootic Hemorrhagic Disease (EHD) is a bigger threat to our deer herd than CWD.
  - Agree
  - Disagree
  - I don't know
  
- CWD does not kill deer.
  - Agree
  - Disagree
  - I don't know
  
- The only way to deal with CWD is to let nature take its course.
  - Agree
  - Disagree
  - I don't know

On a scale of 1 to 5, how strongly would you agree or disagree with the following four statements. (1=strongly disagree, 5=strongly agree).

1. I believe that reducing the population of deer in the affected area will **reduce** the prevalence of CWD in Alabama.

2. I believe that reducing the population of deer in the affected area will **eliminate** CWD in Alabama.
3. I believe that CWD will impact how successful my future hunts will be.
4. I believe that ADCNR's plan to manage CWD in Alabama will be effective.

On a scale of 1 to 5, how comfortable would you be with the following four statements. (1=extremely uncomfortable, 5=extremely comfortable).

1. I am comfortable hunting in regions where CWD has been found.
2. I am comfortable consuming CWD-positive meat myself.
3. I am comfortable with my family (spouse, children, friends) consuming CWD-positive meat.
4. I am comfortable consuming meat from a deer that has not been tested but was harvested in an area where CWD has been found.

On a scale of 1 to 5, how strongly would you agree or disagree with the following four statements. (1=strongly disagree, 5=strongly agree).

1. I am concerned about the current prevalence rate of CWD in Alabama
  2. I am concerned about the spread of CWD across Alabama.
  3. I am concerned that CWD will affect Alabama's wild deer herd's health.
  4. I am concerned that CWD-positive deer in my region will affect my health or my family's health.
- Did you participate in any deer hunts in the CWD High-Risk Zone (Lauderdale County) during the **2021-2022** deer season?
    - Yes
    - No
  - Did you participate in any deer hunts in the CWD Buffer Zone (Colbert County) during the **2021-2022** deer season?
    - Yes
    - No
  - If you knew CWD was present in the area where you hunt, would you be more likely to harvest a doe or a buck?
    - Doe
    - Buck
    - No Preference

- Not Sure
- If you knew CWD was present in the area where you hunt, would you be more likely to harvest a younger buck than what you normally harvest?
  - Yes
  - No
  - Not Sure
- Has the discovery of CWD in Alabama led you to **not** want to hunt deer anymore?
  - Yes
  - No
  - Not Sure
- Do you intend to purchase a deer hunting license for the **next** hunting season?
  - Yes
  - No
  - I have a lifetime hunting license
  - Not Sure
- Where do you plan to hunt **next** season? Select all the apply.
  - [Dropdown List of All Alabama Counties]
- How many deer do you intend to harvest **next** season?
  - [Open-ended Numeric Response]
- Do you intend to participate in voluntary CWD testing in the **future**?
  - Yes
  - No
  - Not Sure

## Appendix B: Louisiana February 2022 Survey Instrument

Please answer the following questions.

- What year were you born?
  - [Open-ended Numeric Response]
- Do you live and/or hunt in Louisiana?
  - Yes
  - No
- Please indicate your race
  - American Indian or Alaskan Native
  - Asian
  - Black or African American
  - White
  - Other [fill in]
- Do you identify with Latino, Hispanic, or Spanish origin?
  - Yes
  - No
  - I prefer not to answer
- Please indicate your gender.
  - Male
  - Female
  - Other [fill in]
  - Other
- What is your zip code at your current residence? (5 digit zip code)
  - [Open-ended Numeric Response]
- What was your household income in 2019?
  - \$0-\$20,000
  - \$20,001-\$30,000
  - \$30,001-\$40,000
  - \$40,001-\$50,000
  - \$50,001-\$60,000
  - \$60,001-\$70,000
  - \$70,001-\$80,000
  - \$80,001-\$90,000
  - \$90,001-\$100,000
  - \$100,001+
- What is your highest level of education?
  - Did Not Graduate High School/No GED

- High School Graduate/No GED
  - Technical/Vocational School
  - Some College/AA or AS (2 Year Degree)
  - College Graduate/BA or BS (4 Year Degree)
- Did you have a hunting license that allows you to hunt deer for the 2021-2022 Louisiana season?
    - Yes
    - No
  - How many deer do you typically harvest per season in Louisiana?
    - [Open-ended Numeric Response]
  - Did you have a hunting license that allowed you to hunt deer for the 2021-2022 Louisiana season?
    - Yes
    - No
  - How many deer do you typically harvest per season in Louisiana?
    - [Open-ended Numeric Response]
  - What counties do you deer hunt in Louisiana? Select all that apply.
    - [Dropdown List of All Louisiana Parishes]
  - What type of land do you deer hunt on in Louisiana? Select all that apply
    - Personal Lease
    - Lease with Others
    - Public Land
    - Private Property (Personal/Family-owned/Friends)
  - How important is each deer hunting motivation to you? [Select One per Motivation from a 1-5 Likert-scale; 1 least important, 5 most important]
    - Experience Nature/View Wildlife
    - Challenge of the Hunt
    - Solitude
    - Trophy
    - Venison
    - Manage Deer Populations
    - Social Interactions/Experiences
  - How many deer have you harvested or intended to harvest in the 2021-2022 deer season?
    - [Open-ended Numeric Response]
  - Have you previously participated in voluntary CWD testing with your harvests in Louisiana?
    - Yes

- No

Based on your current knowledge, are each of the following statements true or false?

- CWD has been found in free-ranging deer in Louisiana.
  - True [Correct Answer]
  - False
  - Not Sure
- CWD has been found in captive deer in Louisiana.
  - True
  - False [Correct Answer]
  - Not Sure
- CWD testing in Louisiana is available at no cost to the hunter through the Louisiana Department of Wildlife and Fisheries.
  - True [Correct Answer]
  - False
  - Not Sure
- CWD has been found in all states that border Louisiana.
  - True [Correct Answer]
  - False
  - Not Sure
- Has a CWD-positive sample been found in Tensas, Franklin, or both parishes?
  - Tensas [Correct Answer]
  - Franklin
  - Both
  - Neither
- What type of emergency regulations were passed in the CWD zone after the suspected CWD-positive in Louisiana? Select all that apply.
  - Export of Carcasses [Correct Answer]
  - Ban ALL baiting (including bait not normally ingested by deer)
  - Ban Supplemental Feeding [Correct Answer]
  - Ban Use of Backyard Bird Feeders
  - Other (fill in)
  - None of the Above

Please answer the following questions regarding information pertaining to CWD.

- Is the information you need regarding CWD in Louisiana easily accessible to you?
  - Yes
  - No
- What is your preferred source to obtain information regarding CWD in Louisiana?

- Friends/Family
- State Wildlife Agency
- Social Media
- News Sources
- I have not looked for CWD information before
- Other (fill in)

Do you agree or disagree with the following statements?

- CWD can infect humans.
  - Agree
  - Disagree
  - I don't know
  
- CWD has been in Alabama since the 1960s but was just recently discovered.
  - Agree
  - Disagree
  - I don't know
  
- CWD is an uncommon disease in the US, so it isn't a threat.
  - Agree
  - Disagree
  - I don't know
  
- Epizootic Hemorrhagic Disease (EHD) is a bigger threat to our deer herd than CWD.
  - Agree
  - Disagree
  - I don't know
  
- CWD does not kill deer.
  - Agree
  - Disagree
  - I don't know
  
- The only way to deal with CWD is to let nature take its course.
  - Agree
  - Disagree
  - I don't know

On a scale of 1 to 5, how strongly would you agree or disagree with the following four statements. (1=strongly disagree, 5=strongly agree).

1. I believe that reducing the population of deer in the affected area will **reduce** the prevalence of CWD in Louisiana.
  
2. I believe that reducing the population of deer in the affected area will **eliminate** CWD in Louisiana.

3. I believe that CWD will impact how successful my future hunts will be.
4. I believe that the Louisiana's Department of Wildlife and Fisheries (LDWF) plan to manage CWD in Louisiana will be effective.

On a scale of 1 to 5, how comfortable would you be with the following four statements. (1=extremely uncomfortable, 5=extremely comfortable).

1. I am comfortable hunting in regions where CWD has been found.
2. I am comfortable consuming CWD-positive meat myself.
3. I am comfortable with my family (spouse, children, friends) consuming CWD-positive meat.
4. I am comfortable consuming meat from a deer that has not been tested but was harvested in an area where CWD has been found.

On a scale of 1 to 5, how strongly would you agree or disagree with the following four statements. (1=strongly disagree, 5=strongly agree).

1. I am concerned about the current prevalence rate of CWD in Louisiana.
  2. I am concerned about the spread of CWD across Louisiana.
  3. I am concerned that CWD will affect Louisiana's wild deer herd's health.
  4. I am concerned that CWD-positive deer in my region will affect my health or my family's health.
- Did you participate in any deer hunts in the CWD Zone (Franklin, Madison, and Tensas parishes) during the **2021-2022** deer season?
    - Yes
    - No
  - If you knew CWD was present in the area where you hunt, would you be more likely to harvest a doe or a buck?
    - Doe
    - Buck
    - No Preference
    - Not Sure
  - If you knew CWD was present in the area where you hunt, would you be more likely to harvest a younger buck than what you normally harvest?
    - Yes
    - No
    - Not Sure



- Has the discovery of CWD in Louisiana led you to **not** want to hunt deer anymore?
  - Yes
  - No
  - Not Sure
  
- Do you intend to purchase a deer hunting license for the **next** hunting season?
  - Yes
  - No
  - I have a lifetime hunting license
  - Not Sure
  
- Where do you plan to hunt **next** season? Select all the apply.
  - [Dropdown List of All Louisiana Parishes]
  
- How many deer do you intend to harvest **next** season?
  - [Open-ended Numeric Response]
  
- Do you intend to participate in voluntary CWD testing in the **future**?
  - Yes
  - No
  - Not Sure