Surveillance and Management Plan for Chronic Wasting Disease in Free-ranging Cervids in Minnesota

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Introduction

Chronic wasting disease (CWD) belongs to a family of infectious diseases, called transmissible spongiform encephalopathies (TSE), which alter the morphology of the central nervous system, resulting in a "sponge-like" appearance of this tissue. Chronic wasting disease affects members of the Cervidae family including elk (*Cervus canadensis*), mule deer (*Odocoileus hemionus*), white-tailed deer (*O. virginianus*), moose (*Alces alces*), and caribou/reindeer (*Rangifer tarandus*). The causative agent of CWD is an infectious protein, called a prion, which accumulates in nervous and lymphatic tissues and has been detected in a variety of tissues and fluids throughout infected animals. Infectious prions have been found in cervid urine, saliva, blood, feces, muscle, antler velvet, and semen (Mathiason et al. 2006, Haley et al. 2011, Pulford et al. 2012, Kramm et al. 2019). Incubation time of the disease, from infection to clinical signs, can range from 1.5 to nearly 3 years (Williams et al. 2002). Clinical signs are non-specific and may include a loss of body condition and weight, excessive salivation, loss of fear of humans, loss of body control, tremors or staggering, drooping head or ears, and apparent confusion (Gilch 2016). There is no known treatment or vaccine for the disease and it is always fatal.

Chronic wasting disease was first discovered in captive mule deer in 1967 in Colorado and then recognized in captive white-tailed deer and elk in 1978. Within wild populations, CWD was historically confined to free-ranging deer and elk in the endemic area of northeastern Colorado and southeastern Wyoming. As of July 2024, the disease has been detected in wild and captive cervids in 34 states across the US, five Canadian provinces, the Republic of South Korea, Finland, Sweden, and Norway.

The Centers for Disease Control (CDC) and other public health agencies have concluded there is no known link between CWD and any neurological disease in humans (MaWhinney et al. 2006), and transmission to humans is extremely unlikely (Kurt et al. 2015, Waddell et al. 2018, Groveman et al. 2024). However, recent research on transmission potential of CWD prions to humanized mice has suggested the species barrier may be less robust than previously thought and calls to question the zoonotic potential of this disease (Hannaoui et al. 2022). Further, preliminary results from an ongoing and yet unpublished study by the Canadian Food Inspection Agency has demonstrated the disease can be transmitted to macaques (*Macaca fascicularis*)

through consumption of muscle from deer naturally infected with CWD. These unpublished findings have sparked renewed concerns about potential human health risks of eating CWD-contaminated venison (Czub 2017). In separate work, also focused on susceptibility of macaques to CWD, Race et al. (2018) found no evidence of successful transmission. The reasons for this scientific ambiguity are unclear, but as a precaution both the CDC and the World Health Organization recommend that humans do not consume any part of a known CWD positive animal.

Experimental and circumstantial evidence suggest that transmission of the disease is primarily through direct contact with infected animals, carcasses, saliva, or excrement (Miller and Williams 2003, Safar et al. 2008, and Haley et al. 2011). Recent research has also suggested vertical or maternal transmission as a possible mechanism of infection. (Bravo-Risi et al. 2021; Nalls et al. 2013, 2021). Theoretically, prions can be shed from infected animals soon after initial infection; in one experimental study prion shedding was detected in deer saliva three months post-inoculation (Henderson et al. 2015), and another study found that deer shed prions in their feces up to a year before showing signs of illness (Tamgüney et al. 2009).

Persistence of prions in the environment and resulting indirect transmission has been shown to occur (Miller et al. 2004, Johnson et al. 2007, and Maluquer de Motes et al. 2008). Recent research has shown prion seeding activity is retained for at least 15 years at a contaminated site, following attempted remediation (S. Lichtenberg, *pers comm*). Prions readily bind with soil particles (Saunders et al. 2012) and other abiotic substances (Plummer et al. 2018, Pritzkow et al. 2018), which can magnify CWD infectivity (Johnson et al. 2007). Certain soil elements, such as clay, appear to enhance the persistence and infectivity of CWD prions (Dorak et al. 2017). Furthermore, plants have been shown to uptake prions from the soil making them available for consumption by herbivorous animals (Pritzkow et al. 2015, Carlson et al. 2023). Conversely, a recent study found that humic acids in soil organic matter may decrease prion infectivity (Kuznetsova et al. 2018). These findings underscore the complex dynamics that prions have with the environment.

All cervids infected with CWD, regardless of their genetic makeup, will die from CWD-associated mortality because no genotype confers complete immunity. However, research has demonstrated that certain genotypes can extend the CWD incubation period and animal survival

time, although these infected individuals may shed infectious prions for a longer amount of time and contribute to environmental contamination (Johnson et al. 2006, 2011; Robinson et al. 2012, Haley et al. 2021, Moazami-Goudarzi et al. 2021). Based on epidemiological modeling, deer with a more CWD-resistant genotype may have a selective advantage in the long term, although it is not clear if there are maladaptive traits associated with their presence (Robinson et al. 2012). More recently, there is evidence that there has been genetic selection among elk due to CWD, but it is unclear whether it is sufficient to mitigate negative population level impacts (Monello et al. 2017). There is much uncertainty regarding how CWD may drive the evolutionary dynamics of cervid populations, but it is clear that the recent discovery and potential for novel CWD strains adds additional complexity (Duque-Velásquez et al. 2015, Otero et al. 2023).

White-tailed deer have significant cultural, social, and economic value in Minnesota. These values extend particularly to tribal communities on both reservation lands and ceded territories where cervids provide sustenance for those communities. On these lands especially, close coordination with tribal partners on all aspects of CWD response activities is critically important. As written in the Minnesota Department of Natural Resources' (MNDNR) White-tailed Deer Management Plan, agency staff coordinate and work with tribes on deer management in accordance with reserved treaty rights, associated court decisions, federal laws, intergovernmental agreements and shared interest in natural resource conservation. In 2019, Governor Tim Walz signed Executive Order 19-24, which was later rescinded and signed into law in the Minnesota 2021 1st Special Session, to facilitate a collaborative relationship and promote engagement with tribal nations through coordination, cooperation, and consultation. The MNDNR acknowledges that this disease may negatively affect treaty resources and influence the ability of tribal members to exercise their treaty rights; close coordination is imperative as specific response plans are developed on reservation lands and ceded territories.

Throughout Minnesota, economic activities related to hunting wild white-tailed deer generate over 500 million dollars annually and revenues from deer hunting licenses support wildlife management activities of the MNDNR. Potential reductions in the participation of white-tailed deer hunting stemming from CWD are a concern for managers. The discovery of CWD in wild cervid populations in neighboring Wisconsin in 2002 resulted in an initial decline in hunting permit license sales of 11% (Vaske et al. 2004, Vaske and Lyon 2011) with associated

impacts on deer hunting related economic activity (Bishop 2003), although most hunters returned quickly. Erickson et al. (2019) further demonstrated that the negative effects of CWD on demand for deer hunting licenses in WI declined over the period 2002 to 2015 as external pressures on demand compensated (e.g., lower participation among an aging population).

The long-term effects of CWD on deer hunting participation are difficult to estimate given the shifting demographics of society, and trends in Americans' interest in hunting in general. Minnesota has witnessed a 1.5% average annual decline in deer hunting license sales from 2012 to present (MNDNR 2024). Some of this decline is likely attributable to CWD and CWD management, but the full extent is unknown. The structure of Minnesota's deer licenses and deer management confound estimates of the effects of CWD on demand since not all deer licenses are explicitly linked to deer permit areas, and management area boundaries have changed with the progression of the disease. Following the discovery of CWD in southeast Minnesota in 2016, there was a 10% decline in the number of hunters reporting the CWD management area as their intended hunt location before the season. Regardless, the presence of CWD presents an additional factor in Minnesotans' decision where to hunt deer.

Of particular concern to deer hunting participation is the species barrier, as several surveys of deer hunters, including in Minnesota, have found that a sizable proportion of hunters state they would cease hunting deer if the disease were transmissible to humans. Any significant reduction in deer hunting licenses sales would present a challenge to the MNDNR's ability to execute management activities for all species given the proportion of revenues that come from deer hunting licenses, and multiplicative impacts on federal funds through the Federal Aid in Wildlife Restoration program. Needham et al. (2004) postulated that upwards of two-thirds of hunters would quit hunting if CWD was transmissible to humans. By extension, a reduction in deer hunters diminishes the capacity of state wildlife agencies to effectively manage deer populations. The MNDNR is not unique in this regard, as license dollars fund the operations of most state wildlife agencies, who are reliant on these fees and Federal reimbursements to deliver management and conservation activities for many species of wildlife and their habitats (Organ et al. 2010). Thompson and Mason (2022) recently reported that nationally, CWD surveillance and management is expensive and may be unsustainable if for no other reason than that the cost per sample for CWD testing is typically more than twice the revenue generated through the sale of a

resident deer hunting license. Since 2002, Minnesota has spent $21.3million on its CWD response program[1], of which 98% were state funds (72% from license fees, 26% state funding, and 2% federal dollars). Until such time as uncertainty is reduced (e.g., human health implications, long-term population concerns), the MNDNR considers CWD response and management a high priority and all necessary resources should be directed to avoid the long-term consequences of an endemic infection.

History of CWD in Minnesota in Farmed Cervids

From 2005 to 2021, the Minnesota Board of Animal Health (BAH) had sole authority for oversight of farmed cervids in Minnesota. In 2017, BAH was audited by the Office of the Legislative Auditor (OLA), and the OLA made several recommendations that the BAH should take to improve oversight. In February 2021, the Minnesota State Legislature amended Chapter 35.155: Chap. 6 Art. 2 Sec. 17 Subd. 14, to grant concurrent authority to MNDNR and BAH for regulatory oversight of farmed white-tailed deer. In 2023, the Legislature again amended Minn. Statute 35.155 to grant sole authority for oversight of farmed white-tailed deer to the MNDNR while BAH retained oversight for all other farmed cervid species.

To date, CWD has been diagnosed in 13 captive cervid herds within the state of Minnesota, including 3 elk herds, 9 white-tailed deer herds, and 1 European red deer (*Cervus elaphus*) herd. Epidemiologic investigations were conducted by USDA and BAH staff following each occurrence of CWD, and results indicate 5 of these herds (40%) were directly linked to another CWD-infected farm through direct animal movements discovered through tracing. Investigations of the remaining 7 herds (60%) failed to determine the point source of the disease with certainty, but risk factors included on-site taxidermy, import of live cervids or semen from high-risk facilities, and other potential sources.

The following is a chronological account of detections of CWD in farm cervid herds:

- 2002: An elk herd in Aitkin County was discovered with CWD as well as an elk herd in Stearns County that received animals from the former. Those herds were both depopulated with no additional CWD positive animals found.

[1] Fiscal year 2024 ($3.5 million) in an estimate.

- 2006: A captive white-tailed deer was found infected with CWD from a mixed deer/elk herd in Lac Qui Parle County. That herd was also depopulated without additional CWD cases being detected.
- 2009: A captive elk herd in Olmsted County consisting of >600 animals was found infected with CWD. Following depopulation, a total of 4 elk were confirmed with the disease and the United States Department of Agriculture (USDA) determined there was an apparent longstanding infection within the herd.
- 2012: A captive European red deer was found infected with CWD in a herd of approximately 400 animals in Ramsey County. This marked the first time CWD was discovered in this species (Schwabenlander et al. 2013). Also in 2012, the USDA discontinued funding to depopulate CWD-infected herds; thus, this herd was quarantined for several years until depopulation finally occurred in 2015 (with no additional CWD positive cases found).
- 2016: Two adult female white-tailed deer were detected with CWD from a captive mixed white-tailed and mule deer herd in Crow Wing County. This facility remained under quarantine as the owner chose not to depopulate the herd; it continued to operate as a shooting pen, although CWD was again detected in this facility in fall 2018.
- 2017: Movements of deer from the Crow Wing County herd to a farm in Meeker County revealed another infected adult female white-tailed deer, which was found dead in the facility and confirmed to have CWD. This herd of 15 deer was depopulated with 5 animals (33% prevalence) testing positive for CWD.
- 2017: In November 2017, CWD was detected in an adult male white-tailed deer that died in a Winona County captive deer facility. An additional adult male harvested in the facility in December 2017 was also confirmed infected with CWD. The remaining seven animals in this facility were depopulated in early 2018 and all deer tested positive for CWD (100% prevalence).
- 2019: The Crow Wing farm was depopulated in spring 2019 and 7 additional deer were identified as positive from 89 deer sampled. On-farm prevalence could not be determined because 13 of 20 found dead deer on the farm were not tested. A CWD positive deer was also detected in a small hobby farm in Douglas County

this year. An 8-year-old female was killed by its adult male pen-mate. The female was found to be CWD positive, while the male was euthanized and CWD was not detected.

- 2020: A Pine County farm, which provided the animals to the Douglas county herd, was found infected with the disease in January. This herd was depopulated and 5 of 9 (55%) deer were CWD-positive. In October, an adult doe on a farm in Houston County was found positive for CWD in October. In total, 10 of 46 (22%) deer were infected with the disease following depopulation in January 2021.
- 2021: A farm in Beltrami County that had received animals from the same source as the Houston County farm was quarantined and later found to be CWD positive. The farm was depopulated and 13 of 54 (24%) deer were infected with CWD. An illegal carcass dump site was discovered on public land adjacent to the Beltrami County farm property and carcass remains of 10-12 deer were matched to the CWD-positive herd. As a result, DNR constructed a 12-acre deer exclusionary fence to reduce risk of wild deer exposure to prions in the environment.
- 2022: A quarantined farm in Winona County, which sourced animals to both the Houston and Beltrami County CWD-positive herds, was found to have CWD. The herd was depopulated in October and 4 of 120 (3%) were infected with the disease.

In an effort to reduce risk of disease spread from CWD-infected farms to wild cervids, the DNR issued expedited emergency rules to temporarily prohibit the importation and movement of farmed white-tailed deer into and within Minnesota on three occasions between 2019 and 2021. The first two movement bans, which lasted <60 days, were in response to CWD discoveries on deer farms in Douglas (2019) and Houston/Beltrami Counties (2021). Movements of infected deer resulted in disease spread and additional time was needed to conduct epidemiological investigations to reduce risk. The most recent movement ban, issued in October 2021, was in response to a CWD-positive farm in Taylor County, Wisconsin that moved 387 deer into 7 states, including Minnesota. Minnesota state statues provide the DNR Commissioner with the authority to institute these expediated emergency rules to protect the state's wild cervids.

History of CWD in Minnesota in Wild Cervids

In response to the initial discovery of CWD in wild white-tailed deer of Wisconsin and the first Minnesota CWD-positive captive elk herd in 2002, the MNDNR developed a comprehensive wild deer CWD surveillance program. This included surveillance of hunter-harvested and opportunistically encountered vehicle-killed and clinical-suspect deer, elk, or moose. A clinical-suspect cervid is defined as exhibiting physical signs, behavioral abnormalities, and/or locomotor difficulties consistent with CWD infection (Gilch 2016). From 2002–2004, nearly 28,000 deer were tested for CWD statewide with no positive results. Sampling occurred at the deer permit area (DPA) level with 95% confidence that the disease would have been detected if present in ≥1% of the deer population in each DPA. Following completion of statewide surveillance, and no evidence of a long-standing infection in Minnesota, the MNDNR adjusted surveillance efforts and focused sampling of wild cervids in response to elevated risk factors. These risk factors include 1) detection of CWD-positive animals in a captive cervid facility in Minnesota, 2) proximity of positive CWD cases in wild deer in neighboring states, and 3) testing of clinical-suspects of CWD and other special wild cervid cases. These elements constitute the MNDNR's risk-based approach to CWD surveillance in Minnesota and permit more efficient use of finite resources (financial and personnel), as opposed to continuous statewide sampling. With this approach, some areas of the state (where risk factors remain low for an extended time period) would lack certainty that CWD remains absent and may warrant surveillance effort when resources allow. Since 2005, the MNDNR has tested an additional 110,000 deer for CWD using risk-based surveillance.

The first wild white-tailed deer found infected with CWD in Minnesota occurred in fall 2010, during the second year of risk-based surveillance efforts surrounding the CWD-positive captive elk facility in Olmsted County in 2009. From 2011–2013, MNDNR implemented the 2011 CWD Response Plan and over 4,000 deer were tested in this immediate area; no additional positives were detected (Hildebrand et al. 2013). The MNDNR concluded the disease was either found early enough to prevent transmission or local conditions favored a failure of disease establishment (Hanley et al. 2022). The CWD Management Zone that had been created through the response plan was dissolved in 2014, and harvest regulations and zone boundaries returned to what they were prior to the discovery of CWD.

Since the initial discovery of CWD in a wild deer in Minnesota, we have had 7 additional areas with introductions of the disease in wild deer across the state from fall 2016 though spring 2024. The following is a chronological account of recent CWD detections in wild deer:

- In fall 2016, surveillance efforts were prompted by a risk-based approach as detections of CWD in wild deer from western Wisconsin and northeastern Iowa increased and further encroached on Minnesota borders. As a result of this effort, three adult males were found infected with CWD in Fillmore County (DPA 348). Again, MNDNR implemented the 2011 CWD Response Plan and additional samples were collected during winter 2016-2017, which resulted in eight more CWD-positive deer found in a small geographic area near Preston, Minnesota. Initial disease prevalence was estimated at 0.36% within the newly established CWD Management Zone (DPA 603), with nearly all CWD cases found within a 64mi^2 core area. Over the next 5 years, continued surveillance suggests the disease is persisting, albeit at low levels (apparent prevalence between 0.60 – 1.12%). However, the most recent assessment of apparent prevalence from fall 2023 was 2.64%, suggesting the disease is increasing in apparent prevalence and established in this area. In 2019, the boundary of DPA 603 was dissolved back to its original DPA designations (DPAs 647 and 648) as new detections of CWD spread outside of the CWD Management Zone
- In fall 2018, CWD was discovered in wild deer adjacent to an infected deer farm in Winona County which was depopulated in 2017 (100% infection rate in the herd) with a history of poor fencing. Positive cases have continued to be found spatially associated with the cervid farm and have spread outward. To date, 65 deer have tested positive for CWD in DPA 646, the disease seems to be persisting at a low level. Apparent prevalence has slightly increased from 2020 (0.72%) to 2023 (1.09%).
- In winter 2019, a deer was found dead 0.5mi from a CWD-positive deer farm discovered in 2017 in Crow Wing County that resulted in precautionary surveillance of wild deer in the surrounding area. Since that initial detection, 2 additional wild deer have been detected out of >13,000 deer tested, suggesting there is no endemic disease in the wild.
- In winter 2020, a sick wild deer was reported by the public near Chub Lake Wildlife Management Area in Dakota County. This deer was confirmed to have CWD and an exposure source could not be determined. To date, 16 additional CWD-positive deer have

been detected in this area, suggesting the disease is persisting at a low apparent prevalence rate of 0.26%.

- In fall 2021, a hunter-harvested wild deer was submitted directly to a testing laboratory by a hunter in Polk County and was found to have CWD. The location of this deer was within a mile of the North Dakota border, along the riparian corridor of the Red River Valley. Subsequent testing has identified 3 additional cases along the same corridor; exposure source has not yet been determined.
- In winter 2022, a vehicle-killed deer was tested for CWD in the city of Grand Rapids in Itasca County and found positive. Three additional deer from the immediate area have since tested positive for CWD. Subsequent testing in the surrounding area has not revealed additional disease. Exposure source could not be determined; however, urban areas have been considered higher risk for CWD from people transporting high risk deer parts to their homes.
- In fall 2022, 2 hunter-harvested male deer were found positive in Hubbard County through precautionary surveillance initiated in 2021, due to a CWD-positive deer farm discovered in 2021 with a high-risk illegal carcass disposal site. These deer were harvested 10 miles south of Bemidji and >35 miles from the infected deer farm. Exposure source has not yet been determined.

The current footprint of CWD in wild cervids in Minnesota has resulted in the creation of six unique CWD Management Zones, spread across the state since 2016. However, the vast majority of CWD-positive deer (89%) are from southeast Minnesota, with only 6% of cases occurring in the southern Twin Cities area and 5% of cases occurring in northern Minnesota. While harvesting a CWD-positive deer remains a rare occurrence for Minnesota hunters, the number of hunters impacted by regulations centered around the surveillance and management for the disease has increased markedly.

Risk-based Surveillance for CWD in Wild Cervids of Minnesota

The MNDNR goal for CWD surveillance in wild cervids is to detect the disease, if it is present, as early as possible since introduction. Since 2005, the MNDNR has relied on a risk-based surveillance approach that identifies risk factors related to CWD introduction into wild cervids, which include:

1. Discovery of CWD in a Minnesota captive cervid facility.
2. Recent detection or significant spread of CWD in wild cervids in a bordering state or province.
3. Detection of CWD through testing of clinical-suspects or other special cervid cases.

When these risk factors are identified, MNDNR will initiate a series of actions to conduct precautionary CWD surveillance. The MNDNR will also alert tribal authorities once a CWD-positive detection has been confirmed or if there is significant CWD risk from a bordering state or province; federal resource managers, non-governmental organizations, and other stakeholders in the affected area will also be notified about surveillance plans. This will enable effective partnering to support CWD surveillance goals.

For all MNDNR CWD surveillance efforts, the data collection process will include the extraction of both medial retropharyngeal lymph nodes, determination of sex and age class for each animal, and identification of the harvest location. Typically, sampling effort is focused on yearling (between 1 and 2 years of age) and adult (>2 years of age) cervids. Generally, fawns (<1 year of age) will not be tested for CWD given the low probability of testing positive; however, there may be exceptions to this general rule. All samples will be inventoried, entered into a database, and sent to an accredited laboratory for enzyme-linked immunosorbent assay (ELISA) testing. Positive ELISA samples will be considered "suspect-positive," until confirmatory testing using immunohistochemistry testing (IHC) is performed at either the accredited laboratory or the National Veterinary Services Laboratory in Ames, Iowa. If additional diagnostic testing options become available in the future and complete a nationally recognized validation process, considerations will be made to incorporate those into our testing protocols.

Discovery of CWD in a Minnesota Captive Cervid Facility

If CWD is detected in a captive cervid facility in Minnesota without white-tailed deer, the Minnesota Board of Animal Health (BAH) has the lead role of response inside the facility, including further testing of captive animals, determining the source population, and identifying if animals were recently sold to other farms in Minnesota or other states (called trace-out facilities). For captive herds containing white-tailed deer or mixed herds that contain white-tailed deer, MNDNR has the lead role and responsibilities related to the epidemiological investigation and

resulting actions. The MNDNR will determine if wild cervids in the surrounding area are infected with CWD by conducting precautionary surveillance in the immediate area for a minimum of 3 consecutive years, which may include hunter-harvested surveillance, special hunts, landowner shooting permits, and agency-directed culling.

The following activities will occur as quickly as possible, regardless of the time of year the discovery is made:

a. Implement a recreational feeding ban to reduce contact rates and decrease disease transmission potential until surveillance in wild cervids has been completed. At a minimum, this area would include the county containing the infected facility and any surrounding county that encompasses at least 2 miles or more within a 15-mile radius of the farm.
b. Establish a CWD Surveillance Zone around the infected captive cervid facility. During the initial response year, this would include the DPA containing the infected facility and all or portions of surrounding DPAs. If an adequate sample is collected and disease is not detected in a wild cervid the first year, the surveillance area may be reduced to a more localized area around the facility in subsequent years.

Following these initial steps, a surveillance strategy will be designed to determine if CWD is present in the wild cervid population. The sampling method(s) will be dependent upon multiple factors, such as 1) the wild cervid density and distribution surrounding the positive facility, 2) the history of wild cervid surveillance in the area, 3) expected volume of hunter-harvested deer in the area, 4) the overall compliance of the infected facility to regulations designed to minimize CWD transmission risks, and 5) the timing of the discovery relative to the next hunting season. After evaluating each of these factors, the decision will be made whether to obtain samples for CWD testing from hunter-harvest efforts and/or other mechanisms such as special hunts, landowner shooting permits, or agency-directed culling. Further, there will be increased efforts to sample clinical-suspect and vehicle-killed wild cervids, when possible. Any confirmed positive CWD cases in wild cervids discovered through these efforts will trigger transition from precautionary surveillance to our initial response to CWD detection in wild cervids. The precautionary surveillance period will occur for 3 consecutive years, the maximum observed incubation period of the disease in cervids under experimental settings. In each of these years,

MNDNR will collect adequate samples to ensure at least 95% confidence that CWD would be detected if prevalence is ≥1% in the underlying wild cervid population. After 3 years, MNDNR would reevaluate the risk and determine if continued surveillance or other precautionary activities are necessary.

Recent Detection or Significant Spread of CWD in Wild Cervids in a Bordering State or Province

Currently, CWD has been found in wild cervids in all the US states surrounding Minnesota, as well as the Canadian province of Manitoba. In the Dakotas, CWD has been found in mule deer, white-tailed deer, and elk but the infection remains in the western portions of these states with low risk of spread into Minnesota from natural wild cervid movements. However, CWD has been increasingly found in wild white-tailed deer in northeastern Iowa and western Wisconsin, where the potential for disease spread into Minnesota through natural deer movements is an ongoing concern. In 2021, Manitoba detected its first CWD positive in wild mule deer on its Western border shared with Saskatchewan. Since this detection in 2021, the province has identified 26 more positive CWD deer, both in mule deer (22) and white-tailed deer (4) and has observed a radial geographic spread closer to North Dakota and Minnesota to the south and southeast.

Wildlife professionals in the surrounding states and provinces routinely exchange information on CWD surveillance and detections in their jurisdictions. These ongoing communications help MNDNR assess risk of disease incursion into wild cervid populations at our borders. When new cases of CWD are found near Minnesota's border or there has been significant spread of the disease from an endemic area towards Minnesota, the MNDNR's risk-based surveillance efforts will be implemented. The surveillance response will include:

- Sampling of hunter-harvested wild cervids in the DPA or DPAs closest to encroaching CWD cases in the neighboring state or province. An adequate sample will be collected to ensure at least 95% confidence that CWD would be detected if prevalence is ≥1% in the underlying cervid population.
- Increased efforts to sample clinical-suspect and vehicle-killed wild cervids, when possible, in the DPAs closest to encroaching CWD cases in the neighboring state or province.

Any confirmed positive CWD cases in wild cervids discovered through these efforts will trigger transition from precautionary surveillance to our initial response to CWD detection in wild cervids. If the disease is not detected, MNDNR will evaluate the need for continued surveillance beyond one year.

Detection of CWD through Testing of Clinical-suspects or Other Special Cervid Cases.

Year-round and across Minnesota, clinical-suspect wild cervids found exhibiting symptoms consistent with CWD infection will be tested for CWD when possible. In some cases, cervids found dead that exhibit emaciation, in the absence of observed abnormal behaviors, may also be tested for CWD. This may include the testing of vehicle-killed deer, at the discretion of field staff and available resources; yet this surveillance method by itself not effective as an early disease detection tool and typically cost prohibitive. Clinical symptoms of CWD infection are non-specific and may be due to a multitude of other causes, diseases or health conditions, these suspect animals have been shown to have a higher probability of CWD infection compared with apparently healthy deer in areas with established CWD infection (Walsh and Miller 2010, Jennelle et al. 2018). Recently, a deer study from the CWD endemic area in southern WI reported that infectious disease was the leading suspected cause of death, with high prevalence of CWD (42.4%; of 245 evaluated) and pneumonia (51.2%; of 168 evaluated) being the most common clinical conditions (Gilbertson et al. 2022). In areas where CWD is not known to exist or has gone undetected, samples from cervids exhibiting clinical signs associated with CWD are considered high value and are a useful albeit opportunistic source for detecting the disease. For example, in Illinois the first documented wild white-tailed deer with CWD was detected in 2002 after sampling a clinical suspect; the adult female from Boone County had aspiration pneumonia, food impaction, and behavioral abnormalities (Illinois DNR 2013). In Arkansas during February 2016, along with a CWD-positive hunter-harvested elk, a clinical-suspect white-tailed deer tested positive for CWD; these animals heralded the discovery of CWD in Arkansas (Arkansas Game and Fish Commission 2018). Further, the initial discovery of CWD in Dakota County, Minnesota in 2020 was through sick deer surveillance of an emaciated, neurologic adult male deer reported by a member of the public. Clinical-suspect cervids are reported opportunistically to MNDNR when they are encountered by the public, law enforcement, hunters, or field staff, and in most cases, emaciation is the primary cause for concern. Since 2002, MNDNR has tested >1,000 clinical-suspect cervids throughout the state.

Northern Minnesota is home to a small-to-moderate population of both wild elk and moose. Limited hunting opportunities sometimes occur for these species and MNDNR tests harvested animals for CWD as a precautionary measure. Further, opportunistic reports of sick moose or elk with neurologic symptoms consistent with CWD will also be screened for the disease at necropsy. Since 2004, >250 elk from northwest Minnesota and >350 moose from the northeast were tested for CWD with no detections (Carstensen et al. 2015). While these species have very small population sizes in Minnesota, their ranges overlap with wild white-tailed deer. Elk, in particular, also undergo short-distance migratory movements into Canada and perhaps North Dakota, thus increasing contact rates with cervids outside of our jurisdiction.

In cases when a captive cervid(s) escapes from a facility and is reported running at-large to MNDNR, efforts will be made to recover or euthanize and test these animals for CWD as a precautionary rule-out for the disease. The escaped cervid(s) may be euthanized by the owner and testing will occur through established protocols. Often, MNDNR is asked to assist in dispatching of these animals and samples are collected for CWD testing; test results are shared with BAH. See the 2022 DNR Escaped Captive Protocol for additional information.

CWD Detection in Wild Cervids: Initial Response, Management of Persistent Infection, and Management of Endemic Disease in Minnesota

Once CWD has been detected in a wild cervid(s), MNDNR will engage aggressively in a series of actions to eliminate the disease, if possible, prevent or minimize disease spread, and detect spread if it occurs. If MNDNR determines that CWD is unlikely to be eliminated from an area, using a set of pre-defined triggers, we will transition to the containment and management of a persistent infection on the landscape. If MNDNR determines that CWD is established in an area and the disease cannot be eliminated, we will transition to the management of endemic infection. The suite of available actions will generally progress through a process outlined in the following stages:

1. Initial Response to CWD Detection in Wild Cervids.
2. Management of Persistent CWD Infection in Wild Cervids.
3. Management of Endemic CWD Infection in Wild Cervids.

Initial Response to CWD Detection in Wild Cervids

In the event that CWD is identified in a wild cervid in Minnesota, the goals of MNDNR's initial management response to CWD detection are to: 1) act aggressively to eliminate the disease, if possible, 2) prevent or minimize disease spread, 3) collect adequate samples to monitor disease prevalence and spread, and 4) engage stakeholders and provide accurate and current information about CWD to agency personnel, tribal partners, stakeholders, the public, and legislators. To meet these goals, the following actions will occur as soon as possible and include:

a. Work closely with tribal partners on all aspects of the response and continued management, especially where the disease occurs on or near reservation lands or ceded territories.
b. Conduct outreach activities related to CWD discovery, meet with stakeholders, and schedule a public meeting to inform interested individuals of the MNDNR short-term response plan.
c. Where possible, once adequate snow occurs, complete an aerial survey in the immediate area surrounding the CWD-positive detection(s) to estimate wild cervid population density and distribution on the landscape.
d. Establish a CWD Management Zone (which will approximate a 15-mile radius around the positive detection), the exact size of which will depend on the locations and distribution of infected cervids as well as DPA boundaries. Recent research has supported this zone size as adequate to contain 82% of long-distance movements of wild deer in southeast Minnesota, where both dispersal and migratory behaviors were documented (Jennelle et al. 2022). It is possible this zone will increase in size as new information becomes available. Creation of a CWD management zone is dependent on identifiable and enforceable boundaries. Ideally, the DPA containing the wild positive is fully included within the new CWD Management Zone. If at least 2 miles of the 15-mile radius encompasses the adjacent DPAs they will be added to a surveillance zone in the first year to gather more information on disease apparent prevalence and spatial distribution. All DPAs determined to have a CWD positive will become part of a 600-series identifier (e.g., DPA 346 will change to DPA 646), which clearly identifies the DPA as within a disease management zone

for rule-making and other communications.

e. Implement a cervid recreational feeding and attractant ban to reduce contact rates and decrease disease transmission potential. At a minimum, this area would include the county containing the positive wild deer and any surrounding county that encompasses at least 2 miles or more within a 15-mile radius of this detection.
f. Institute and enforce carcass movement restrictions out of the CWD Management Zone of all deer (including fawns), and only allow certain parts (i.e., quarters or other portions of meat with no part of the spinal column or head attached, or the head and portion of the neck may be transported to a licensed taxidermist within 48 hours) to leave prior to receiving test results.
g. During initial discovery population management goals will be paused and the focus will be on reducing wild deer densities within the CWD Management Zone and, more specifically, around locations of CWD-positive deer to reduce opportunities for transmission. Theoretically this will increase harvest and enhance our sampling efforts, providing more information on disease apparent prevalence and spatial distribution. Once adequate data is obtained, population management goals can continue and harvest designations can reflect population goals, so long as they do not conflict with disease management.
h. Establish a CWD Surveillance Zone for enhanced surveillance in all or portions of DPAs that surround the CWD Management Zone for one fall hunting season to determine spatial extent of the disease outbreak. If no other DPA boundaries intersect with a 15-mile radius from the location of the CWD positive deer, this sampling effort may be delayed to further determine spatial extent of disease within the CWD Management Zone and adapt accordingly.
i. For deer permit areas within a CWD management zone, the ‘minimum’ harvest designation must be either-sex (one-deer limit), unless strong justification is provided for Lottery (or Bucks Only). For example, if repeated years of adequate surveillance indicate a very low prevalence rate.
j. Conduct mandatory CWD sampling at adequate levels to monitor changes in prevalence and disease spread. MNDNR will collect adequate samples to ensure at least 95% confidence that CWD would be detected if prevalence is ≥1% in the

underlying wild cervid population of that (each) DPA.

k. Develop a communications and outreach plan to inform and engage agency partners, the public, and stakeholder groups.

The sampling method following initial detection will be dependent upon the timing of the discovery in relation to the next upcoming hunting season. If there is sufficient time for the rule-making process to implement changes by the next hunting season, then hunting opportunities will be liberalized and hunter-harvested surveillance will be used as the primary method of determining the disease prevalence and spatial distribution. Regulations will mandate the presentation of the carcass of any cervid harvested within the CWD Management Zone at officially designated sites within the zone. Sample collection methods will be similar to those previously described in the risk-based surveillance methods; however, for adult cervids, a front incisor may be extracted to estimate age by cementum annuli. A muscle sample for genetic analysis may also be collected. Hunter-harvest surveillance will become an annual occurrence and be designed to monitor changes in the apparent prevalence and spatial distribution of the disease. Hunting opportunities within the CWD Management Zone will be liberalized to increase harvest and ensure adequate numbers of cervids are available for sampling. Regulatory alternatives could include, 1) increased or unlimited bag limits, 2) elimination of special rules that protect specific classes of deer (e.g., antler point restrictions [APR]), 3) institute special hunts, 4) allow harvest of multiple antlered deer per hunter, 5) conduct agency-directed culling, and 6) issue landowner shooting permits. If numbers of hunter-harvested deer are not sufficient to provide an adequate estimate of disease apparent prevalence and spatial distribution, the MNDNR will consider additional options to collect supplemental samples. These options may include taxidermist networks to obtain high value CWD samples (adult male deer) and agency-directed culling. Additionally, voluntary testing opportunities may be implemented to provide hunters the ability to have deer tested prior to movements out of restricted zones or to alleviate concerns regarding consumption of venison. Following annual surveillance, locations of positive cervids will be evaluated and the boundaries of the CWD Management Zone will be adjusted, if necessary.

If there is insufficient time for the rule-making process to implement changes to the hunting seasons following the discovery of a CWD positive wild cervid, the MNDNR will assess disease prevalence and spatial distribution through the use of any or all of the following tools, 1)

designating special hunts, 2) offering landowner shooting permits, and 3) agency-directed culling. In addition, efforts will be made to raise awareness and encourage reporting of clinical-suspect cases. These efforts will be followed up by liberalized hunting opportunities and hunter-harvest surveillance during the following fall hunting season.

The MNDNR will continue hunter-harvest surveillance in the CWD Management Zone for a minimum of three consecutive years with an adequate sample. Sampling goals will be established to assure at least 99% confidence that CWD would be detected if it occurred in >1% of the local deer population, during each year following initial detection. Efforts will be made to provide on-site quartering tripods and disposal options (dumpsters) at central locations within the CWD Management Zone to reduce the risk of potential transport of CWD-infected carcass material outside the zone. If additional CWD-positives are found, the response efforts will continue and MNDNR will determine if a trigger has been met to transition into management of a persistent infection. If no additional CWD-positive wild cervids are found over this 3-year surveillance period, the MNDNR will reevaluate the risk and determine if continued surveillance is necessary. At such time, the CWD Management Zone may be dissolved and DPA boundaries would revert back to their original designation. Any established population management goals will be paused, and the focus will be on reducing wild deer densities within the CWD Management Zone. Once adequate data is obtained, population management goals can continue and harvest designations can reflect population goals, so long as they do not conflict with disease management.

Transition to Management of a Persistent CWD Infection

Wildlife disease control strategies must be based on an understanding of specific disease etiology and epidemiology, and the dynamics of the cervid population(s). Where infectious diseases exist at a significant prevalence or over a wide-spread area, they may be impossible to eliminate from wild animal populations and the environment. CWD has a long incubation period and coupled with its ability for lateral transmission and environmental contamination, once persistent in wild deer in Minnesota, the disease may only be managed to minimize its impacts and limit spread to new areas of Minnesota. Therefore, MNDNR has identified 4 primary triggers that would signal the shift from response of initial CWD detection to the management of persistent CWD infection in wild cervids:

1. Apparent CWD prevalence is >1% of deer sampled in the CWD Management Zone during the initial sampling effort, which would suggest the disease is not new and may already be established in the affected area.
2. Apparent CWD prevalence is <1% of deer sampled in the CWD Management Zone during initial sampling effort, but increases and includes more infected females during consecutive years of surveillance.
3. The spatial extent of the disease expands beyond the initial affected area and suggests the disease has spread.
4. Apparent CWD prevalence is low (e.g. <1% in adult deer) in the CWD Management Zone during the initial sampling effort and remains low during consecutive years of surveillance, but is not decreasing and disease is found in younger animals (e.g., deer < 2 years old) indicating active transmission.

Management of Persistent CWD Infection in Wild Cervids

If CWD is determined to be persistent in wild cervids, the MNDNR will implement additional mechanisms to manage the disease and prevent spread. The goals for managing persistent CWD infection in wild cervids will include, 1) contain CWD infections within the CWD Management Zone, 2) minimize the impact of the disease statewide, 3) reduce the prevalence in affected areas, 4) collect adequate samples to monitor disease prevalence and spread, 5) provide accurate and current information about CWD to the public, agency personnel, and stakeholder groups, and 6) engage in applied research to better understand the epidemiology, transmission, and management of CWD. To meet these goals, the following actions will occur as soon as possible:

a. Manage for a younger age structure in the CWD Management Zone to maintain a higher rate of population turnover through liberalized harvest opportunities and elimination of any special rules to protect specific classes of deer, if they exist (e.g., APR, buck cross-tagging).
b. Increase antlered deer harvest (e.g., allowing harvest of multiple antlered deer per hunter), as adult bucks have a greater chance of having CWD.
c. Emphasize harvest efforts in optimum habitat(s) where deer movement is most likely to occur, such as riparian drainages.

d. Per statute (97A.045, subdivision 11), issue a replacement license to hunters that have harvested a CWD-positive wild cervid.
e. Do not increase overall deer density in the CWD Management Zone in order to lower emigration rate and distance traveled by dispersing deer from the CWD Management Zone (mitigating potential disease spread outside the zone).
l. Continue the cervid recreational feeding and attractant ban to reduce disease transmission opportunities.
f. Continue to enforce deer carcass movement restrictions out of the CWD Management Zone. Only allow certain parts (i.e., quarters or other portions of meat with no part of the spinal column or head attached, or the head and portion of the neck may be transported to a licensed taxidermist within 48 hours) to leave the zone prior to receiving test results.
g. Designation of CWD Core Area(s), defined as areas where multiple CWD-positive cervids have been detected in close geographic proximity. CWD Core Areas will be designated by a 1-mile buffer of surrounding sections (1 mi^2) where positive deer are detected (Appendix B). These areas represent the known highest risk for CWD transmission between wild deer and through contamination of the environment with infectious prions and will take priority for intensive management actions to mitigate disease spread.
h. Consider the use of incentives for landowners and hunters to remove CWD-positive deer from the CWD Management Zone and Core Areas. These incentives, which may be financial or non-financial (e.g., cash rewards, life-time deer hunting licenses, hunting-related merchandise, donation to local charities, etc.) may be given to hunters, landowners, and/or the communities where CWD positive cervids are detected. Hunter and landowner surveys conducted in the CWD Management Zone (and surrounding areas) will help inform the acceptance and feasibility of the array of possible incentives.
i. If efforts to significantly reduce deer numbers in CWD Core Areas are insufficient through recreational hunting (regular and special seasons), agency-directed culling will likely occur to increase the probability of removing infected individuals from the landscape and reduce disease transmission. Culling efforts may include removal of social groups associated with adult female CWD-positive deer because research has demonstrated that fine-scale group removal can be effective for managing CWD in wild

deer (Grear et al. 2010).

j. Develop a communications and outreach plan to inform and engage agency partners, the public, and stakeholder groups.

As with initial response actions, following implementation of these additional CWD management mechanisms, the prevalence and spatial distribution of the disease will be assessed through the sampling of wild cervids. All sampling and testing procedures, as well as data collected and databases maintained, will be consistent with initial management efforts.

Transition to Management of an Endemic CWD Infection

There is a lot of uncertainty surrounding the determination of when CWD is established in the affected population and no effective management strategy will eliminate the disease from the landscape. Functionally, this new reality could be phrased as "living with CWD". There is no disease management handbook in existence that clearly defines when a CWD outbreak has achieved endemic status. However, through statistically valid disease surveillance that provides an adequate sample over multiple years and includes a representative sample of all sex and age cohorts, inferences can be made as to when a CWD infection is endemic. MNDNR has identified 3 surveillance thresholds that would signal the shift from either initial CWD response or persistent CWD management to managing for endemic CWD in wild cervids:

- Apparent CWD prevalence is >5% of deer sampled in the CWD Management Zone during the initial sampling effort, which would suggest the disease was established in the affected area when discovered.
- Apparent CWD prevalence is <5% of deer sampled in the CWD Management Zone during initial sampling effort but increases over a 3-year monitoring period to exceed 5%, and infected individuals include more adult females, and yearlings, or fawns of either sex.
- The targeted removal of deer in CWD Core Areas has been utilized as a management action; however, has not significantly reduced disease prevalence within the CWD Management Zone. We assume disease transmission is now both lateral (animal-to-animal) and indirect, as environmental contamination has become significant with a high prevalence of disease on the landscape. In this case, the continued targeted removal of social groups is unlikely to break transmission cycles, as uninfected individuals

immigrating into the affected area have a high probability of exposure to CWD through prions found in contaminated soil, plants, or other substrates.

Management of Endemic CWD Infection in Wild Cervids

If CWD is determined to be endemic in wild cervids, the MNDNR will reduce efforts to aggressively manage this disease within the CWD Management Zone and shift focus and resources to preventing spread to new areas of the state. The goals for managing an endemic CWD infection in wild cervids will include, 1) minimize the impact of the disease statewide, 2) collect adequate samples to monitor disease prevalence and spread, 3) utilize liberal harvest regulations to reduce the prevalence in the endemic area, 4) aggressively respond to new detections of disease outside of the endemic area, 5) provide accurate and current information about CWD to the public, agency personnel, and stakeholder groups, and 6) apply adaptive management to adjust efforts as new information on successful CWD mitigation strategies emerge. To meet these goals, the following actions will occur as soon as possible:

a. Aggressively respond to any new detection of CWD outside the CWD Management Zone, by utilizing hunters, landowners, and agency-directed culling to reduce deer numbers within 2 mi^2 of this detection.
b. Continue to manage for a younger age structure in the CWD Management Zone to maintain a higher rate of population turnover through liberalized harvest opportunities.
c. Conduct periodic, mandatory sampling of hunter-harvested deer in the CWD Management Zone to monitor changes in disease prevalence and spread (e.g, sampling occurs every 3-5 years).
d. Implement voluntary surveillance options for deer harvested within the CWD Management Zone, such as self-service, sampling kiosks and self-mailing test-kits.
e. Continue the cervid recreational feeding and attractant bans to reduce disease transmission opportunities.
f. Continue to enforce deer carcass movement restrictions for all deer (including fawns) out of the CWD Management Zone. Only allow certain parts (i.e., quarters or other portions of meat with no part of the spinal column or head attached or the head and portion of the neck may be transported to a licensed taxidermist within 48 hours) to leave the zone prior to receiving test results.
g. Develop a communications and outreach plan to the public and stakeholder groups.

Supporting Strategies and Evidence

Most states across the US that have discovered CWD have implemented some type of response or management plan. No single state has been successful in eliminating the disease from wild cervids once it has become endemic, but Illinois has been successful in controlling CWD prevalence with localized intensive management (Manjerovic et al. 2014, Varga et al. 2021) and efforts to remove entire social groups of deer (Tosa et al. 2016). The key factor is the level of infection determined in the cervid population at the time of initial detection. For example, when Wisconsin first discovered CWD in wild deer in the southwestern part of the state in 2002, it was assumed to be a recent introduction of the disease and management strategies initially focused on disease eradication. However, subsequent surveillance revealed that the disease was already widespread at the time of discovery and modeling suggested that CWD had been on the landscape for at least 20 years (Jennelle et al. 2014). From 2002– 2023, Wisconsin tested >316,000 wild deer, of which over 12,000 tested positive. Wisconsin has CWD in wild or farmed deer in 49 counties, or 68% of the state.

Despite an initial policy of CWD eradication when the disease was discovered in 2002, Wisconsin essentially relaxed their intensive CWD management efforts after 2007 due to political and social pressures mounting against how the agency was managing the disease (Holsman et al. 2010). The consequences of this passive approach to CWD management in wild cervids are demonstrated to result in high endemic levels of CWD prevalence that can have negative impacts on populations. CWD prevalence within core areas of Wisconsin have shown an overall increasing trend in all sex and age classes. During the past 20 years, the trend in prevalence in adult males has risen from 8-10% to 50% and in adult females from 3-4% to nearly 35% in Iowa County, Wisconsin. Simulation modeling suggests that sustained intensive harvest of antlered deer could eventually reduce prevalence (Jennelle et al. 2014), but may severely disrupt the hunting culture in Wisconsin. Moreover, reports of clinical-suspect deer on the Wisconsin landscape are on the rise. In earlier years (2007-2011) the Wisconsin Department of Natural Resources (WDNR 2018) responded to an average of 22 CWD suspect deer per year in the Southern part of the state with about 30% of those suspect deer testing positive. In subsequent years (2011-2014) WDNR has responded to an average of 44 CWD suspect

deer in this area with about 45% testing positive. WDNR tested 127 suspect deer from across the state from April 1, 2017 to March 31, 2018, and 90 were CWD-positive (71%).

In some cases, when CWD is first detected in wild cervids, the extent of disease impacts may be far-reaching. For example, in northwestern Arkansas in February 2016, CWD was detected in both a hunter-harvested elk and a clinical-suspect white-tailed deer in Newton County. Initial sampling efforts in the vicinity of these cases revealed 23% CWD sample prevalence, which suggests that the disease had been present in the underlying deer population for many years. Further sampling in the surrounding counties has resulted in additional CWD detection in wild deer, and it is clear that Arkansas is dealing with an established and growing CWD cluster. Finding such an advanced disease prevalence in the underlying deer population greatly reduces the chances for disease eradication and warrants a policy of disease containment.

Studies from Colorado and Wyoming demonstrate the disease can ultimately cause deer population declines. Prevalence in adult male mule deer on winter ranges in Colorado more than doubled within a 6-year period, reaching levels of 25-40%, and researchers concluded that high prevalence and low survival of infected deer was sufficient to have caused a population decline (Miller et al. 2008). A study of a white-tailed deer population in southeastern Wyoming from 2003-2010 documented a 10.4% annual decline due to CWD (prevalence rates were 32 - 44%), where infected deer were 4.5 times more likely to die annually than non-infected deer (Edmunds et al. 2016). A study of a mule deer population in Wyoming experiencing more than 20% CWD prevalence, was found to be declining annually by 21% under the best supported models (DeVivo et al. 2017). Further, a study on the impacts of CWD on deer survival in Wisconsin's endemic area showed collared deer with CWD died at three times the rate of uninfected animals (WNDR 2018, Gilbertson et al. 2022). This important project is providing unequivocal evidence of CWD-associated mortality of white-tailed deer, which previous modeling has suggested (Samuel and Storm 2016).

Several examples do exist where CWD was detected in wild deer and did not become established in the local deer population. New York discovered CWD in a wild deer that was geographically associated with a CWD-positive captive cervid facility. Initial surveillance in 2005 indicated <0.1% prevalence in wild deer surrounding the captive

facility (only one positive deer was found) and subsequent surveillance efforts have failed to detect more positives in the wild. In New York's situation, apparent early detection and the swift response taken by the wildlife agency appears to have occurred prior to CWD becoming endemic in the wild population. Similarly, MNDNR's first occurrence of CWD in a wild deer in Olmsted County in 2010 was found in close association (2 miles) from a CWD-positive captive cervid (elk) facility. Through aggressive surveillance actions over the next 3 years, no additional infection was found and the disease did not appear to have become established. Lastly, a single CWD-infected doe was found in Washburn County in northwestern Wisconsin in 2011, hundreds of miles from known endemic areas within the state. Nearly 3,000 additional deer were sampled in that county from 2012-2017, with no additional positives found. Hanely et al. (2022) found that "one and done" or failed outbreaks of CWD can occur when the outlook for an epidemic hinged on transmission rates, the magnitude of environmental contamination, and system type (density or frequency dependent).

Based upon the current understanding of CWD in wild cervids, eradication of the disease, once established as an endemic infection in the wild population, is not a realistic management objective within the infected area. However, as New York, Wisconsin, and Minnesota's past experience have shown (for both CWD and bovine tuberculosis), if the disease is detected in wild cervids before it has become established in the area, an aggressive approach can help limit its growth and spread. Research on disease transmission, susceptibility to infection, improved surveillance and management strategies continues in many states and have included multi-state collaborations using combined datasets for improved inference.

Adaptive Management

The MNDNR has adopted an adaptive management strategy in its approach to wildlife disease outbreaks, which is structured to facilitate learning from management activities and allows flexibility to alter disease management activities depending on effectiveness of the methods applied, future research results, and public acceptance. This is in accordance with recommendations for adaptive management of CWD created by the Western Association of Fish and Wildlife Agencies (WAFWA 2017) and Best Management Practices (BMPs) for prevention, surveillance and management of CWD created by the Association of Fish and Wildlife Agencies

(AFWA 2018).

As an example of the concept of adaptive management, deer management practices will be influenced by new and ongoing research aimed at demonstrating how CWD spreads on the landscape by wild cervids. Based on extension of recent work modeling the spread (i.e., diffusion) of disease across the landscape (Hefley et al. 2017), preliminary results suggest that the rate of CWD spread is accelerated along riparian drainages and riverine habitat. This supports the notion of emphasizing deer harvest efforts along these strategically important and preferred habitats for deer (Norbert et al. 2016, Edmunds et al. 2017) to minimize CWD spread outside the management and buffer zones. Ahmed et al. (2024) used machine learning models with CWD surveillance data from 16 eastern and midwestern states and found that hunter harvest (proxy for deer density), distance to steams, clay-based soils, and forest cover were the top predictors of CWD incidence. Use of advanced tools such as this can inform surveillance planning and help predict effectiveness of management actions aimed at curbing disease spread.

What the Discovery of CWD Means for Minnesota's Hunters

Ultimately, deer hunters in Minnesota will be an integral component of the CWD response plan and deer population management. Although the CDC, National Institute of Health, and other public health agencies have concluded there is no known link between CWD and any neurological disease in humans (MaWhinney et al. 2006, Sandberg et al. 2010, Groveman et al. 2024), it is still recommended that people avoid the consumption of venison from infected deer. It will be the hunter and their families' decision to consume the meat of a confirmed-positive animal.

Hunters can expect continued surveillance in existing CWD Management Zones and occasional establishment of CWD Surveillance Zones when elevated risk triggers the need for more testing. The testing in designated CWD Management Zones will be provided free of charge to hunters and will primarily consist of mandatory sampling during the opening weekend of firearms deer season, although a wide variety of voluntary sampling options will continue to be available during all deer seasons (archery, firearm and muzzleloader). The MNDNR will also work with taxidermists to obtain samples from high value deer (adult males) for surveillance so the cape or shoulder mount of the animal will not be destroyed. The discovery of CWD in wild deer will have an impact on deer population numbers and hunting opportunities. In the short

term, there may be an expansion of opportunities in the form of special hunts and more liberal bag limits. In the long-term, hunters can expect fewer and younger deer in localized areas as densities must be kept low to minimize disease spread. There will also be more regulations regarding the import/export of whole deer carcasses and carcass parts. To help minimize risk of any infected carcasses leaving the CWD Management Zone, dumpsters will be strategically placed for hunters to properly dispose of carcass remains, assuming adequate funding exists to support this activity. There will also be quartering or butchering stations/tripods set-up near these dumpsters, allowing hunters to quarter their deer and leave the CWD Management Zone prior to receiving their test result. The deer donation program will be expanded to allow hunters an option for additional harvest of deer in areas critical for CWD management. Additionally, recreational deer feeding and use of artificial and natural deer attractants will be banned in counties that contain CWD Management Zones and some surrounding counties as well.

Applied Research

Management of CWD will require a more thorough understanding of the disease and underlying deer populations, including how it is spread and how we can optimize control strategies that ensure a healthy deer population and provide recreational and subsistence opportunities for hunters. The MNDNR will support and conduct, on a priority basis, applied research that will facilitate continued understanding of CWD dynamics in white-tailed deer. The MNDNR will continue to monitor research that is occurring on CWD and other TSEs to ensure the most current and comprehensive information is utilized. Research will be aimed at improving the management of the disease. Specific research objectives may include:

1. Research on the epidemiology and population effects of CWD on Minnesota's wild deer population.
2. Research on deer movement in the local deer population to better predict potential disease spread.
3. Research to evaluate the effectiveness of specific management strategies.
4. Continue research on the relatedness of CWD-infected individuals to assess control strategies that include removal of family groups in CWD Core Areas.
5. Construction of epidemiological models to better predict how CWD will behave on the landscape, and guide management actions.

6. Human dimension research on attitudes and beliefs of Tribal communities, landowners, hunters, and the general public on CWD management actions.
7. Collaborate with other states or regions working with combined datasets to address CWD surveillance or management issues that cross jurisdictional boundaries.

CWD Communications

Chronic wasting disease is of interest to both the hunting and non-hunting communities at the local, national, and international level. As the public agency charged with managing CWD in Minnesota's wild deer population, the MNDNR has an obligation to provide timely, complete, and accurate information about all aspects of the disease to the public. To ensure effective and transparent communication with the general public, tribal authorities, stakeholder groups (including federal resource managers, non-governmental organizations, and others), and the media about CWD, the MNDNR will develop and follow a communication plan. This will include updates on MNDNR's website, news releases, brochures, videos, podcasts, articles in local newspapers or magazines, social media messaging, and public meetings or informal workshops related to CWD. Resources about CWD on MNDNR's website will include current surveillance and CWD-positive detection status, future surveillance plans, information about CWD, videos about how to quarter a harvested deer or collect samples for CWD testing, and the ability for hunters to look up CWD test results.

Effective and timely communication is critical for successful CWD management response efforts; it provides transparency for agency actions, builds relationships between the agency and stakeholders, and lays the foundation for informing and educating the public and partners involved. The MNDNR has recently added two positions dedicated to working with landowners, hunters, and recreational resources users on CWD-related information and education. A human dimensions' research scientist was hired to focus specifically on deer, and CWD will be a significant portion of that work. Furthermore, the MNDNR will continue to partner with landowners and hunting groups, such as Bluffland Whitetails Association, the Minnesota Deer Hunters Association, Minnesota Conservation Federation, Backcountry Hunters and Anglers, and The National Deer Association to engage with stakeholders about past, current,

and future scientific products that are driving our collective understanding of the management of CWD in wild cervids.

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Appendix A. Glossary of Terms

Adaptive Management: A systematic approach for improving resource management activities and policies by learning from alternative management approaches. The idea of learning from experience and modifying subsequent behavior in light of that experience.

Agency-directed culling: Removal of cervids from a focused area carried out by trained professionals. On private property, this activity is not undertaken without the clear consent and the signing of a contract between the private landowner and contractor (e.g., United States Department of Agriculture-Wildlife Services).

Apparent CWD prevalence: The proportion of confirmed CWD-positive cervids from a total sample of cervids tested in a specific area and time frame.

Clinical CWD suspect: A cervid that exhibits physical signs, behavioral abnormalities, and/or locomotor difficulties consistent with CWD infection. Although clinical signs of CWD infection are non-specific, they may include a loss of body condition and weight, excessive salivation, loss of fear of humans, loss of body control, tremors or staggering, drooping head or ears, and apparent confusion.

Confirmed CWD-positive: A cervid that has tested positive for both the first-round screening test for CWD infection (enzyme-linked immunosorbent assay - ELISA) and the confirmatory test for CWD infection (Immunohistochemistry - IHC), which is a gold standard test certified by the USDA.

CWD Core Area: A defined area where multiple CWD-positive cervids have been detected in close geographic proximity. They are designated by a 1-mile buffer of surrounding sections (1 mi^2) where CWD-positive deer have been detected. These areas represent the known highest risk for CWD transmission between wild deer and through contamination of the environment with infectious prions, and will take priority for intensive management actions to mitigate disease spread.

CWD-Management Zone: A defined area no less than 15 miles around a CWD-positive detection, the size of which will depend on the locations and distribution of infected cervids as well as the density, distribution, and understanding of seasonal movements of the local cervid population. This Zone will be the basis for CWD management efforts which will include carcass movement restrictions, deer density reduction, agency-directed culling, special hunts, landowner permits, etc.

Deer Permit Area: A spatial unit that is defined by special deer harvest regulations that are determined by previous harvest rates, estimated population density, and stake-holder inputs.

ELISA: Enzyme-linked Immunosorbent Assay, which is a specialized initial screening test for CWD infection in a cervid. This assay uses an antibody, and the intensity of the antibody binding is read by an instrument that assigns a numerical value to the amount of binding. Intensity values over a predetermined threshold indicate the presence of CWD prions.

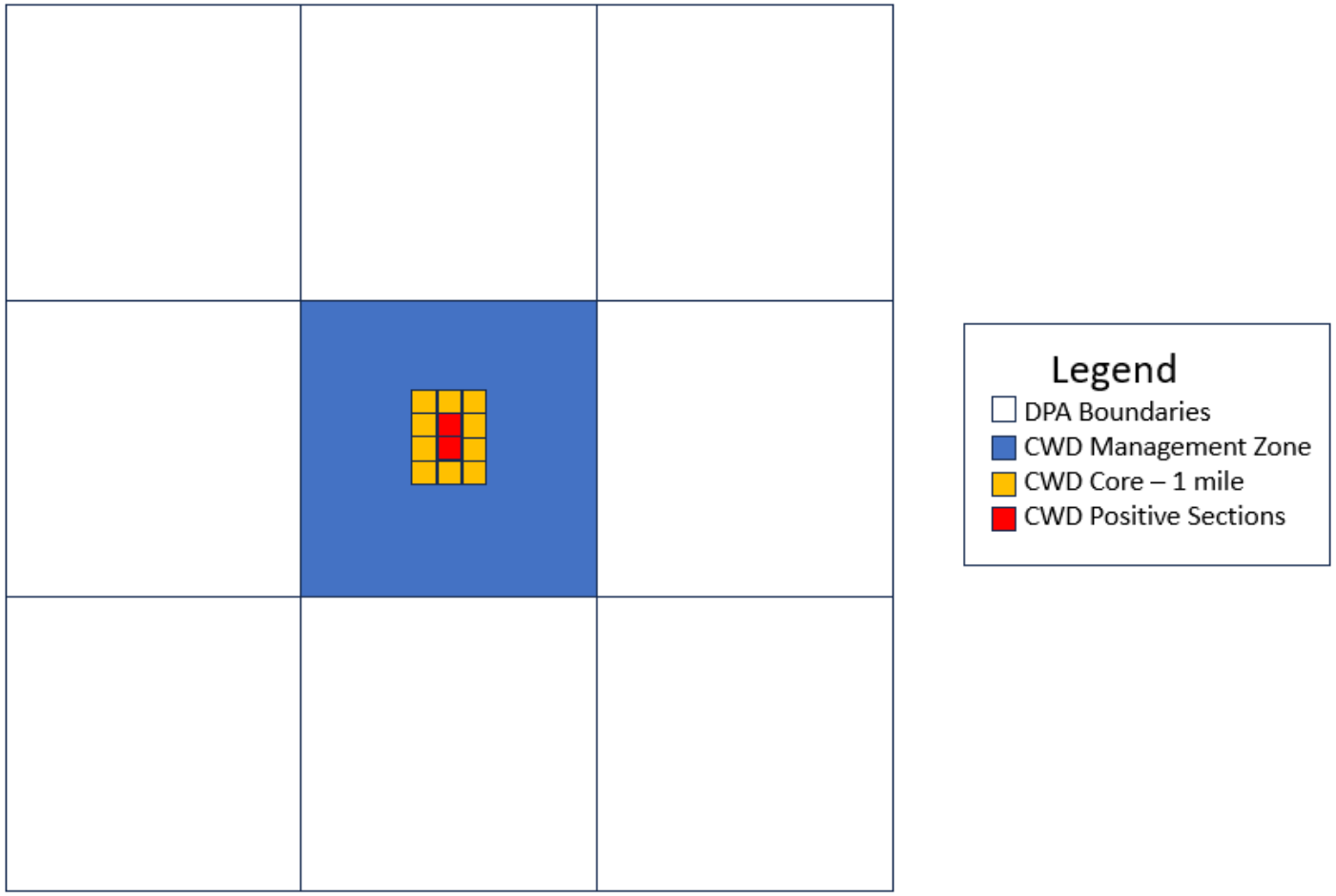
Endemic CWD Infection: This term means that CWD is established in the affected population and is maintained without external inputs. The disease prevalence and spatial extent of infection is consistent and has the potential to increase in the affected area. Transmission between deer is efficient and constantly occurring, and more young deer (yearlings and fawns) are found infected through sampling efforts annually. Once CWD is endemic, existing efforts may not be sufficient to eliminate CWD from the area.

IHC: Immunohistochemistry, which is a specialized confirmatory test for CWD infection in a cervid. It involves the staining of infectious prions in a very thinly sliced tissue sample (either medial retropharyngeal lymph nodes or obex) and magnification via a microscope.

Initial CWD detection: An initiating event when CWD is detected in a wild cervid for the first time in an area. Detection will likely occur through our risk-based surveillance, meaning the animal was sampled through a planned hunter-harvested surveillance effort or through on-going testing of clinical suspects statewide.

Persistent CWD Infection: A CWD management phase that means CWD continues to exist in the wild, despite actions that may/may not have occurred to eliminate the disease through the initial response phase. The disease remains on the landscape but has not yet been determined to be endemic.

Appendix B. Conceptual representation of CWD Management Zone, and a CWD Core Area. A Core Area within the CWD Management Zone is defined as a section (1 mi^2) within which at least one wild cervid has been confirmed positive with CWD. Note that there may be multiple CWD Core Areas within a CWD Management Zone.



Appendix C. Stages of CWD Response and Key Management Actions.