



CHRONIC WASTING DISEASE SURVEILLANCE IN MINNESOTA'S WILD DEER HERD

Erik Hildebrand, Michelle Carstensen, Chris Jennelle, Margaret Dexter, Lou Cornicelli, Patrick Hagen, and Kelsie LaSharr

SUMMARY OF FINDINGS

Fall 2017 marked the first time mandatory testing for chronic wasting disease (CWD) was utilized as a precautionary sampling method for hunter-harvested white-tailed deer (*Odocoileus virginianus*) in high risk areas of Minnesota. This testing occurred during opening weekend of the firearms deer season, November 4-5, 2017, in 21 deer permit areas (DPAs). Testing in north-central Minnesota was centered on a recently discovered CWD-positive deer farm in Crow Wing County. A total of 7,945 deer were tested and no CWD was detected. Similarly, testing in central Minnesota was centered on a second CWD-positive deer farm in Meeker County. A total of 2,623 deer were tested and no CWD was detected. In southeast Minnesota, 1,341 deer were tested in DPAs surrounding the CWD Management Zone (DPA 603), and 1,185 deer from within DPA 603. Six new cases of CWD were confirmed within DPA 603, bringing the total number of infected deer to 17 from fall 2016 to present. Bans on recreational feeding and attractants were enacted in 16 counties to curtail transmission and disease spread. In late 2017, a third positive deer farm was detected in Winona County; upon depopulation of this herd, there was a 100% infection rate. Surveillance conducted by Minnesota Department of Natural Resources (MNDNR) from hunter-harvested deer will continue in these areas, and more, in fall 2018.

INTRODUCTION

Chronic wasting disease is a transmissible spongiform encephalopathy (TSE) that affects elk (*Cervus canadensis*), mule deer (*Odocoileus hemionus*), white-tailed deer, caribou/reindeer (*Rangifer tarandus*), and moose (*Alces alces*). TSEs are infectious diseases caused by malformed prion proteins, which accumulate in the central nervous system, resulting in cell death and a microscopic "sponge-like" appearance of affected tissues. Incubation time of the disease can range from 1.5 to nearly 3 years, although infected animals have been found to shed prions in their feces up to a year before showing signs of illness (Tamguney et al. 2009, Haley et al. 2011). While infectious prions are primarily found in nervous system and lymphatic tissues, they have also been detected in blood, urine, muscle, and antler velvet. Clinical signs are non-specific and may include a loss of body condition and weight, excessive salivation, ataxia, and behavioral changes. There is currently no known treatment or vaccine for the disease, despite considerable efforts in research and development, and it is always fatal. When clinical signs of infection begin, death will occur within months. Experimental and circumstantial evidence suggest that transmission of the disease is primarily through direct contact with infected animals or their contagious saliva or excrement (Mathiason et al. 2006, Safar et al. 2008). However, 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). Evidence from studies of scrapie in sheep and other experimental systems suggest that infectious prions in the environment can remain viable as infectious agents for years (Georgsson et al. 2006, Saunders et al. 2008). Practical decontamination of suspected

environmental reservoirs of infectious prions is currently not possible, as the agent is extremely durable to degradation.

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, Sandberg et al. 2010). However, new research conducted by the Canadian Food Inspection Agency has demonstrated that by orally administering muscle under experimental conditions from cervids (deer and elk) naturally infected with CWD, the disease can be transmitted to macaques. This finding has sparked renewed concerns about potential human health risks to eating CWD-contaminated venison (Czub, S. 2017, May). In separate work, also focused on susceptibility of CWD transmitted to macaques, the research group found no evidence of successful transmission (Race et al. 2018). These results effectively muddy the waters, and make it unclear exactly what the CWD transmission risk is to primates. Despite this uncertainty, researchers still advise caution and suggest people do not consume game animals confirmed with CWD.

Recently, in late November 2017, the Minnesota Board of Animal Health (BAH) announced CWD was found on a deer farm in Winona County in southeast MN. One adult male white-tailed deer was found dead on the farm and through routine surveillance was confirmed to have CWD. An additional male deer harvested on the farm also tested positive for the disease on December 8, 2017. The remaining 7 animals on this farm were euthanized, all of them tested positive for CWD (100% infection rate). One additional MN deer farm was identified to have received 3 animals from this Winona County positive farm within the past 5 years and was considered a trace-out. The owner of the trace-out farm agreed to depopulate these 3 animals; all were not detected for the disease.

Currently, Minnesota has approximately 398 cervid farms (Minnesota Board of Animal Health, 2018). The current statewide population estimate of wild deer is approaching one million. There is an element of inherent disease transmission risk between farmed and wild cervids. Overall, risk is difficult to quantify because wild deer populations are unevenly distributed across the landscape and range in densities from < 1 to 15 deer/km^2 (i.e., 1 to 40 deer/mi²), fences on these facilities vary in construction quality, and the direct/indirect contact rates between farmed and wild cervids are unknown. In addition, deer farms are sporadically distributed on the landscape and are independent of wild deer densities. In Minnesota, farmed cervids are classified as livestock and managed by the Minnesota Board of Animal Health. MNDNR has no authority to oversee or regulate the farms or the animals. An overview of farmed cervid management in Minnesota can be found at <https://www.auditor.leg.state.mn.us/ped/2018/deerfarmssum.htm>

Since 2002, MNDNR has conducted CWD surveillance and sampled >64,000 wild deer across the state. The first occurrence of this disease in a wild deer was in 2010, when one adult female was found with CWD near an infected farmed elk facility in Pine Island. Aggressive surveillance efforts from 2011-2013 tested an additional >4,000 deer in the surrounding area, and failed to detect another case of CWD in the wild. More recently, in fall 2016, CWD was first detected in Fillmore county wild deer, which initiated the CWD response plan. MNDNR has been closely monitoring disease spread in the neighboring states and conducting additional surveillance efforts near those borders to ensure early detection of the disease. In April 2018, a sick deer was found positive for CWD in Eau Claire County Wisconsin, which will lead to an increase in surveillance efforts on Minnesota's side of the border in fall 2018.

METHODS

To prevent further disease transmission, MNDNR banned recreational deer feeding and use of attractants for deer in a 5-county area in southeastern Minnesota and deer feeding in 11 other counties in central and north-central Minnesota. (Figure 1). MNDNR also implemented carcass

import restrictions in 2016 that prohibit whole carcasses of deer, elk, moose, or caribou from entering the state.

Mandatory hunter-harvested surveillance was conducted at deer sampling stations during the first two days of the 2017 regular firearms deer season, in 21 DPAs in Minnesota (Figure 2). A total of 46 sampling stations were staffed with MNDNR personnel and veterinary or natural resources students to collect hunter information and remove medial retropharyngeal lymph nodes from harvested deer. These stations were distributed across 3 surveillance areas: north-central (DPAs 155, 171, 172, 242, 246, 247, 248, and 249), central (DPAs 218, 219, 229, 277, 283, and 285), and the southeast (343, 345, 346, 347, 348, and 349), as well as the CWD management zone, DPA 603. Stations were selected based on deer volume and distribution throughout each surveillance area to meet sampling goals: 3,600 samples for the north-central, 1,800 samples for the central, and 1,800 samples for the southeast. Hunters were required to present all adult deer (>1 year old) to be tested for CWD, if it was harvested on November 4-5, 2017 from within our surveillance DPAs.

All deer harvested within DPA 603, including archery, firearm and muzzleloader hunting seasons, were subject to additional restrictions: all adult deer (>1 year old) were required to be submitted for testing and special tagging, collection of muscle tissue for genetic analysis, and provide a tooth to determine exact age of adults (> 2 years old). Whole carcasses were prohibited from leaving DPA 603 until a test result of “not detected” was confirmed; test turnaround times were 3-4 business days. However, the following parts were permitted to leave the area without restriction: entire quarters, deboned meat, antlers or skull plate with antlers attached that has all brain material removed, as well as hides and teeth. The head, spinal column, and remaining carcass pieces were to be kept within DPA 603 until test results were known in order to reduce further risk of transmission across the state. All fawns harvested during the firearms season were verified of age class at a sampling station by MNDNR staff and properly tagged; they were not tested and carcasses could leave DPA 603 immediately. A MNDNR-leased refrigerated semi-trailer, kept at 33-38°F, was provided for hunters to use, along with a dumpster to dispose of butchering remains; both items provided hunters viable options after harvesting deer to comply with carcass export restrictions. Hunters checked their results on the MNDNR website using either their MNDNR number from their hunting license or the special carcass tag number assigned to their deer. During non-firearms seasons, when MNDNR staff were not present at sampling stations, head collection boxes were provided at 5 locations throughout DPA 603 with supplies for the hunter to leave information about where the deer was harvested, as well as the head for testing.

All samples were inventoried, entered into a digital database, and sent to Colorado State University (CSU) for enzyme-linked immunosorbent assay (ELISA) testing. Any presumptive suspect-positive deer from ELISA testing was confirmed using immunohistochemistry (IHC) testing at CSU. In addition to taking biological samples, hunter information was recorded at the time of sampling and included: hunter's name, telephone number, MNDNR number, and location of harvest down to Township, Range, and Section. Maps were provided to assist the hunters in identifying the location of the harvest site. Hunters were given an embroidered cooperator's patch, and notified that they would not be contacted with test results unless their deer tested positive.

In addition, 55 Minnesota taxidermists were trained and supplied with collection materials to target trophy bucks harvested from within our surveillance areas throughout all deer hunting seasons; however only 42 in-network, trained taxidermists collected any samples. We offered compensation to these taxidermists of \$5/head or \$10/lymph nodes for deer harvested within our DPAs of interest. This compensation offer was extended for additional samples from adult deer harvested in select DPAs beyond the mandatory opening weekend collection, if the hunter gave explicit permission. Any hunter that showed up to a sampling station with a trophy deer,

and didn't want the cape ruined from the sampling process, had options to fill out additional paperwork to follow thru with the mandatory sampling procedure. If the hunter chose to use an in-network taxidermist, then samples were collected by that taxidermist. However, if the hunter planned to use a different taxidermist, then the hunter was responsible for bringing the caped head to the nearest area wildlife office to fulfill the sampling requirements.

Due to the discovery of additional positive deer within DPA 603 during the fall, additional efforts were made to collect supplemental samples from DPA 603 and the surrounding area during winter 2018 (Jan-March). First, a special late season hunt was established, January 6, 2018 – January 14, 2018 that included DPA 603 and an expanded hunt boundary (Figure 3). This hunt allowed for the use of any unfilled 2017 deer license or the purchase of a special disease management license (available for a reduce cost of \$2.50) and an unlimited bag of either-sex deer. The same carcass movement restrictions and testing requirement from the fall hunt were in place during this special late hunt.

Following the late hunt, shooting permits were offered to landowners within 2 miles of a known positive deer during February 10, 2018 to March 10, 2018. Landowners inside this area were not required to own a minimum amount of acreage to qualify for a shooting permit, but did have to abide by city and state ordinances for discharging firearms. There were no limits to the number or sex of deer that could be harvested from the owner's property and they could designate as many shooters under their permit as desired. The use of high powered center fire rifles under this permit was allowed. The shooter was required to contact MNDNR staff within 24 hours of harvesting by calling a MNDNR CWD hotline and then provide the head of the deer at a collection box located at the Preston DNR Forestry Office within 48 hours. Each carcass was assigned a unique identification tag, and landowners were directed not to transport carcasses outside the surveillance area until a test result of "not detected" was confirmed. The same carcass export restrictions applied to these deer.

Opportunistic deer that were reported by the public, such as vehicle-kills, sick, and found dead deer within DPA 603 were also collected and sampled for CWD

On a statewide basis, MNDNR routinely samples any cervid exhibiting clinical symptoms of CWD infection. We have disseminated information to wildlife staff regarding clinical signs of infection for symptomatic deer. These staff are also provided with the necessary equipment and training for lymph node removal and data recording. The number of samples expected through these efforts is estimated to be less than 100 animals annually, since few reports of deer with clinical signs are received.

RESULTS AND DISCUSSION

During fall 2017, mandatory statewide surveillance efforts sampled a total of 13,094 wild deer, including 481 collected through participating taxidermists. In the north-central zone, 7,945 (2.2x goal) samples were collected with a 92% compliance rate based on registration, and had no detection of CWD. In the central zone, 2,623 (1.5x goal) samples were collected with a 90% compliance rate and no detection of CWD (Figure 4). In the southeast, 1,341 samples were collected, which was 40% short of surveillance goal and had a 68% compliance rate (Figure 5). A total of 1,185 adult deer were sampled from within DPA 603, with a 104% compliance rate, which included the discovery of 6 additional positive deer. Of the 6 deer that tested positive for CWD, all were adult males and 4 were located in the initial core infection area near Preston, MN and 2 were located about 6 miles west, within Forestville/Mystery Cave State Park. Detecting the disease this far to the west in DPA 603 could mean detecting the disease was missed during surveillance efforts of fall 2016/winter 2017, or due to deer dispersal from the core area.

During the special late hunt, a total of 275 deer were sampled for CWD; all were not detected for the disease. A total of 67 permits were issued to landowners during the landowner shooting

permit phase and 19 deer were sampled for CWD (Figure 6). Only 11 (16%) of the landowners that received shooting permits removed at least 1 deer. Through this combined winter surveillance effort, a total of 294 deer were sampled in the CWD surveillance area with no additional positives.

The MNDNR-leased refrigerated trailer was utilized for the duration of both the fall and winter surveillance efforts for deer harvested inside DPA 603. A total of 328 deer were held; 285 and 43 deer during the regular firearms season and special late hunt respectively.

From July 2017 to June 2018, MNDNR collected a total of 41 samples through opportunistic surveillance efforts. This included samples from 6 escaped farmed deer, 5 deer found dead with no apparent injuries, 1 possible escaped farmed mule deer, 1 wild deer that jumped into a farmed deer enclosure, 1 vehicle-killed deer, and 27 free-ranging deer with clinical signs; all tests were confirmed as not detected for CWD.

Surveillance Costs

One of the driving reasons MNDNR wanted to switch from a voluntary to a mandatory CWD sampling framework was to reduce project costs and improve efficiency. Importantly, the comparison of associated costs between the two surveillance formats; however, since this was the first year MNDNR attempted mandatory sampling and it encompassed 3 separate areas of the state, it was not a straight-forward comparison to voluntary sampling in southeast MN in fall 2016.

In fall 2016, CWD surveillance occurred at 30 big game registration stations throughout Zone 3 in southeast MN with a sampling goal of 2,700 deer. This effort involved 65 DNR staff working as station leads and 133 students. Work occurred over all 4 weekends of the 3A and 3B seasons and select stations (n=7) were staffed the entire first week. A total of 2,966 samples were collected and surveillance costs totaled \$364,115. This would equate to \$122.76/sample collected and tested for CWD.

In fall 2017, CWD surveillance occurred at 46 sampling sites, not associated with big game registration stations, in 3 separate areas of the state with a combined sampling goal of 7,200 deer. The effort involved 129 DNR staff working alongside 198 students over just the 2-day opening weekend of firearm season. A total of 11,909 samples were collected and surveillance costs totaled \$886,977. This would equate to \$74.48/sample collected and tested for CWD.

Total expenditures for the CWD sampling effort in 2017 (including the fall hunt, special January hunt, and landowner shooting permit phase) was \$996,990.

After-Action Review

Following the fall hunter-harvest surveillance efforts, an after-action review (AAR) process was initiated. Approximately 1-2 weeks after the mandatory sampling effort, an AAR survey was sent to DNR staff who participated in sampling. The function of this survey was to obtain feedback on a multitude of items including: the adequacy of CWD sampling equipment and supplies, staff preparedness, sampling station logistics, staffing requirements, data entry/proofing, and overall sample organization.

Staff were encouraged to provide other comments relevant to improving the performance and efficiency of the CWD sampling process. Feedback was received from 52 DNR staff participants or about 40% of the DNR staff participants. A few major outcomes thru this process showed needed improvement towards the total number of deer each sampling team could handle in a day; from 60/deer a team per day down to 45/deer a team per day, and more communication and outreach efforts to the public. More energy towards messaging efforts to inform hunters that the CWD test is not a food safety test, and that processing deer as they normally would should not wait until final test results are received. This would alleviate some of the wanton

waste issues that enforcement staff saw for deer harvested outside of the CWD management zone.

Future Surveillance Plans

Mandatory sampling of adult deer (≥ 1 years of age) and restricted whole-carcass movements inside DPA 603 will remain in effect for fall 2018 hunting seasons. Outside of DPA 603, mandatory sampling will occur again in north-central and central areas; however, the surveillance areas have been reduced to focus on the 15mi² area around the CWD-infected deer farms (Figure 7). In southeast Minnesota, surveillance is expanding due to the recent detection of a CWD-positive deer farm in Winona County, a wild deer found positive in Eau Claire County, Wisconsin, and the continued discovery of infected deer within DPA 603. In total, MNDNR plans to sample >4,150 hunter-harvested deer for CWD during the first 2 days of both the A and B firearms seasons through a mandatory sampling framework. Targeted CWD surveillance of deer exhibiting clinical signs of illness will continue statewide.

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Counties with Deer Feeding and Attractants Prohibited

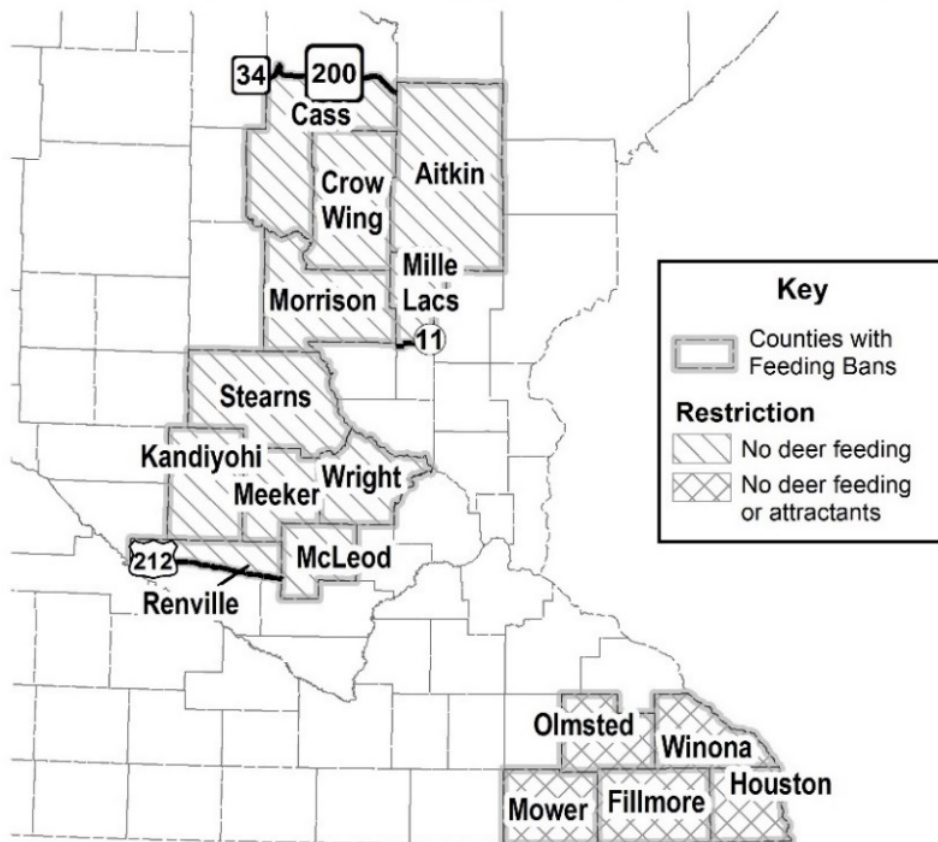


Figure 1. Minnesota counties under a ban on recreational deer feeding or deer feeding and use of attractants, 2017.

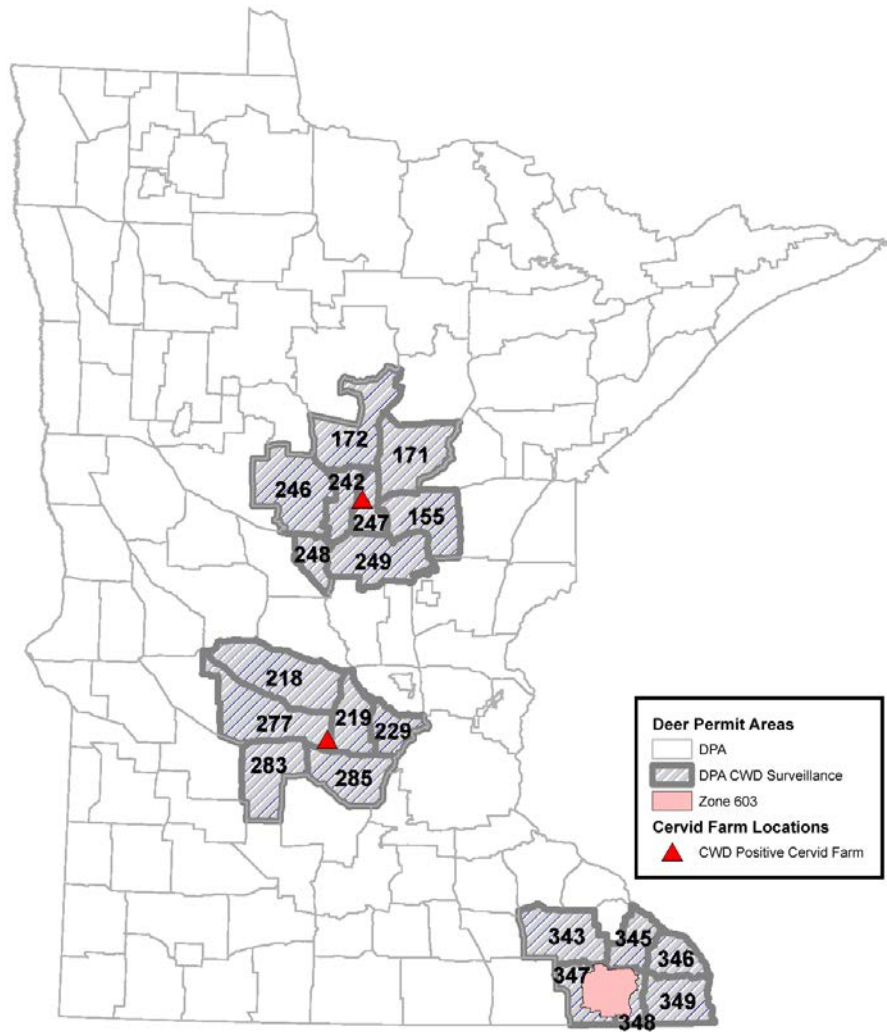


Figure 2. Chronic wasting disease (CWD) surveillance efforts throughout Minnesota, fall 2017.

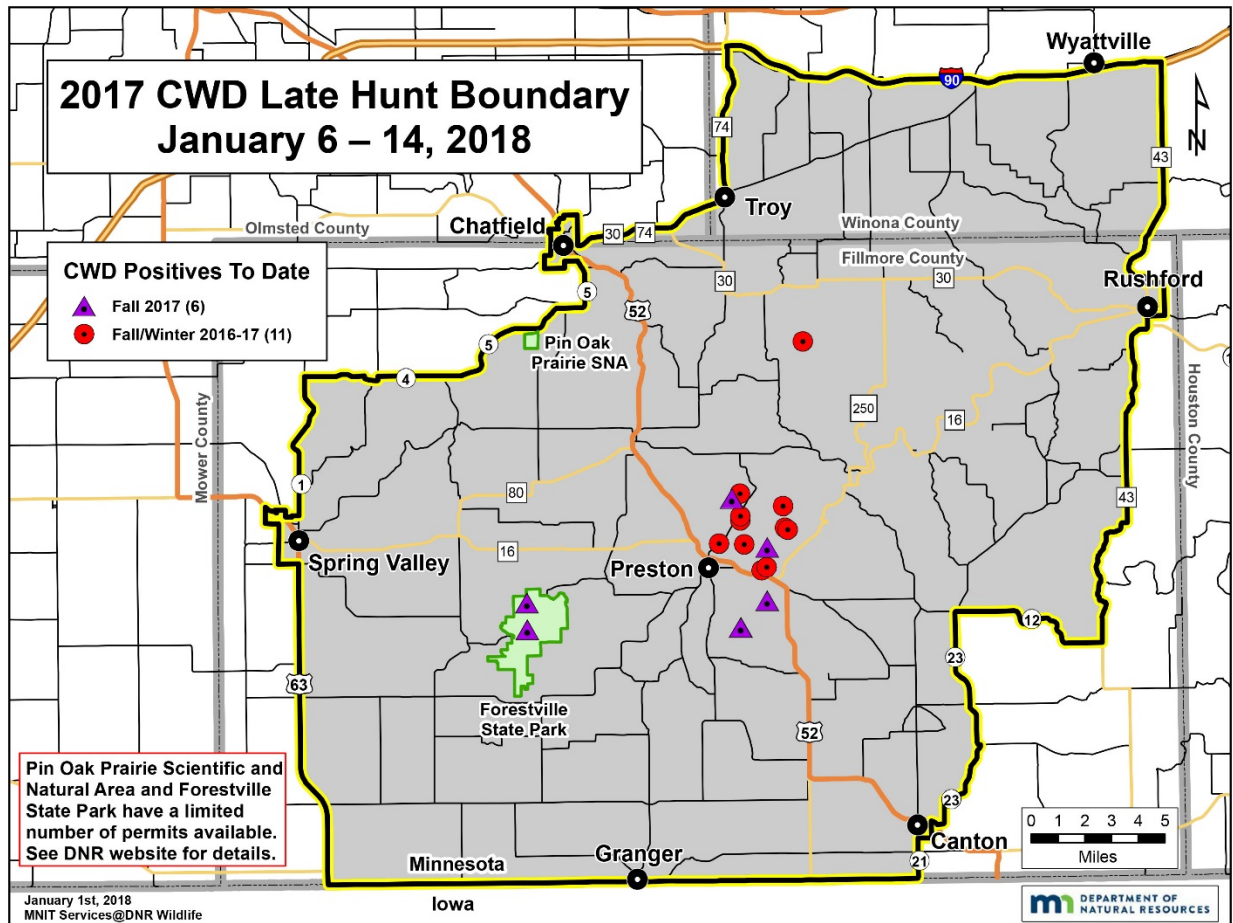


Figure 3. Chronic Wasting Disease (CWD) special late hunt boundary in southeast Minnesota, January 6 – 14, 2018.

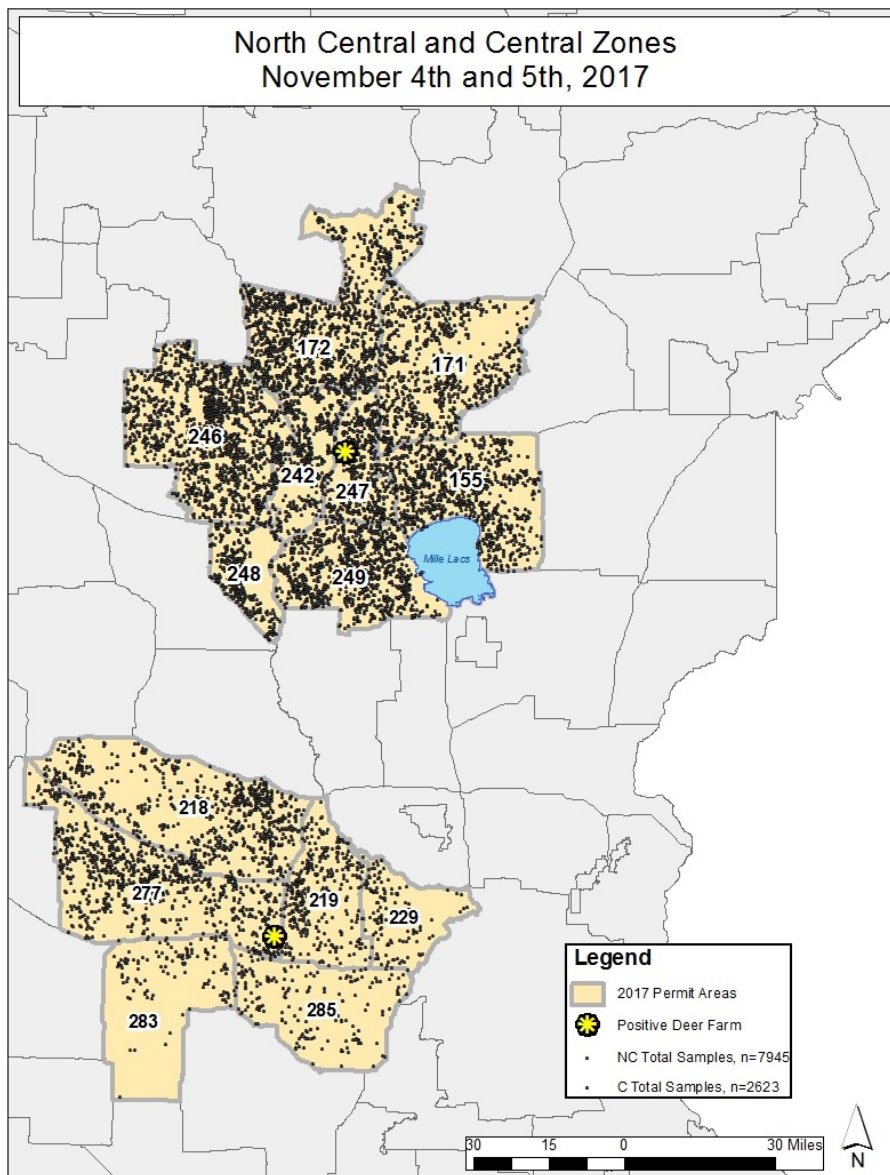


Figure 4. Chronic wasting disease (CWD) samples collected in north-central (n=7,945) and central (n=2,623) surveillance deer permit areas (DPAs) of Minnesota, fall 2017.

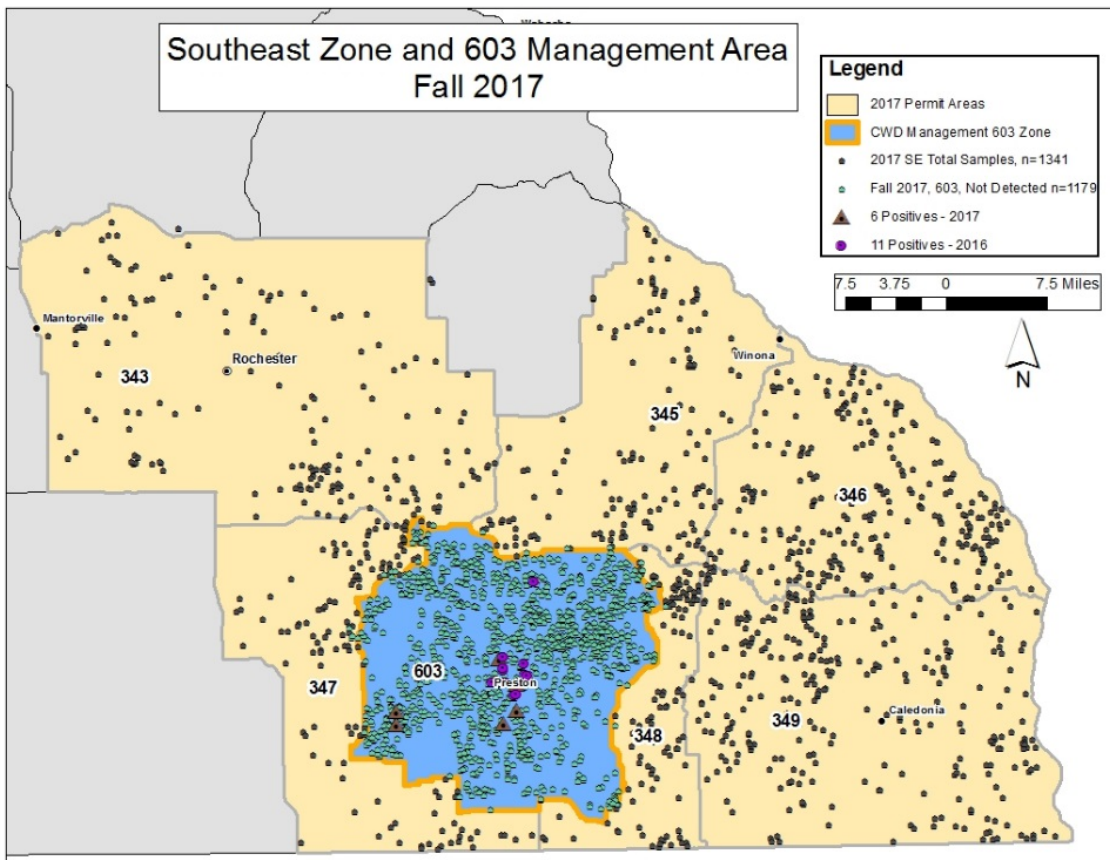


Figure 5. Chronic wasting disease (CWD) samples collected from wild deer in southeast deer permit areas (DPAs) (n=1,341) and DPA 603 (n=1,185) in Minnesota, fall 2017.

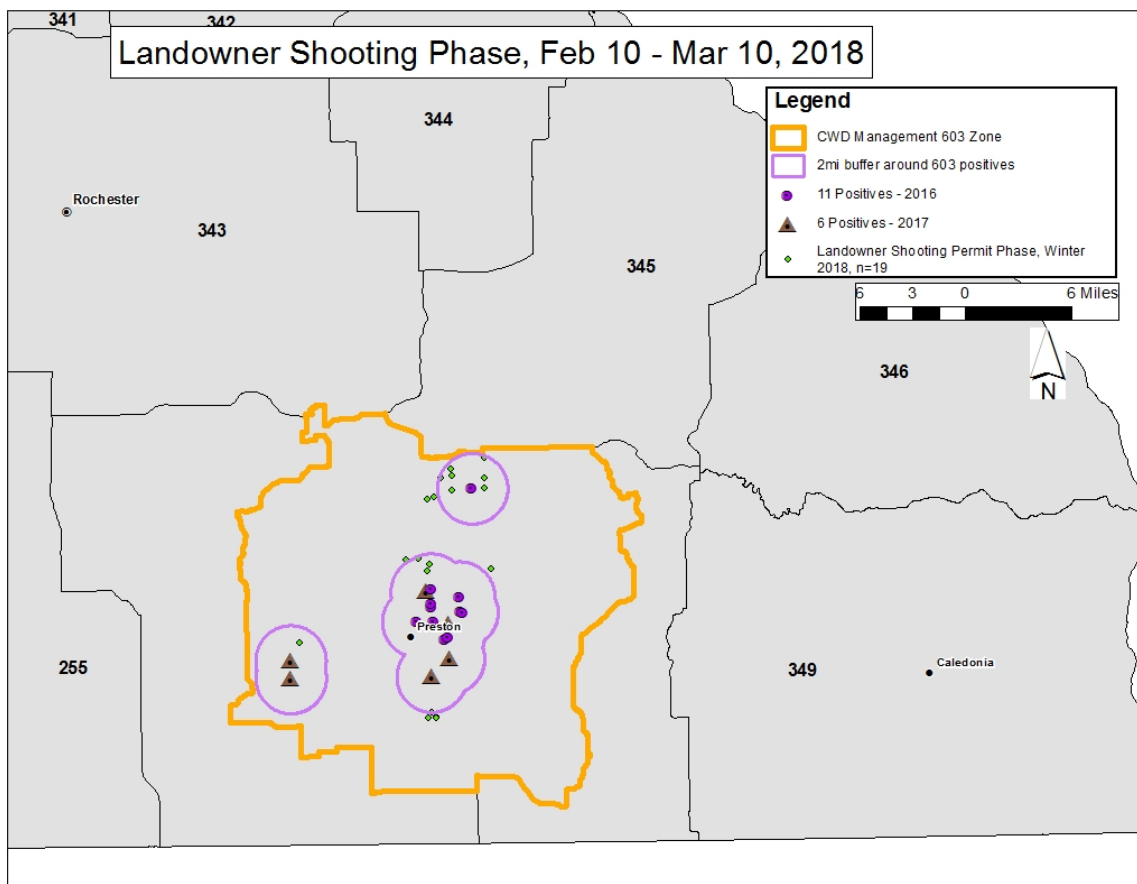


Figure 6. Chronic wasting disease (CWD) sampling efforts during the landowner shooting permit phase (n=19) in deer permit area (DPA) 603 in Minnesota, winter 2018.

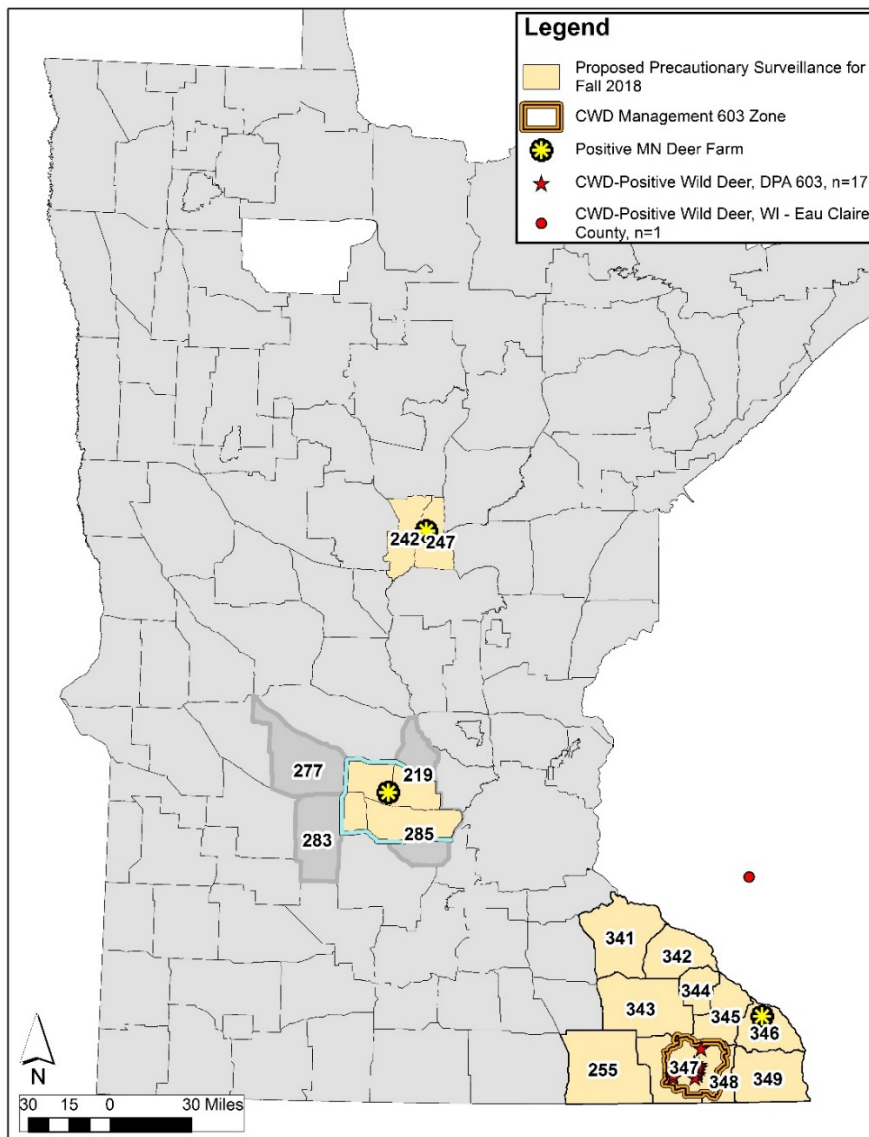


Figure 7. Chronic wasting disease (CWD) surveillance efforts in deer permit areas (DPAs) in Minnesota, fall 2018.