

Risk-Weighted Surveillance for Chronic Wasting Disease in New York



Krysten L. Schuler, Nicholas Hollingshead, Rachel C. Abbott, Lauren Miller, Jeremy Hurst, and Kevin Hynes

CORNELL WILDLIFE HEALTH LAB | NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

SEPTEMBER 2022

Contents

Introduction	2
CWD Background	4
CWD Impacts for New York.....	5
Economic Value of Wild Deer Herd.....	6
Risk Assessment	6
Outside New York	6
Surveillance Programs in Neighboring States	7
Movement of Cervid Carcasses or Parts	7
Feeding & Baiting	7
Captive Cervid Facilities	7
Inside New York	9
Meat Processors and Taxidermists	9
Captive Cervid Facilities	13
NYSDEC Risk Perception Survey	14
Surveillance Plan	16
Past surveillance efforts.....	16
Weighted Surveillance	16
Statewide Point Quota.....	18
County Point Quotas.....	18
Hazard Risk Score	19
Demographic Score	20
County Surveillance Category	21
County Sampling Point Quotas for 2022-2023	22
Implications and Recommendations for NYSDEC Biologists.....	22
Taxidermist Program.....	23
Acknowledgments.....	28
References	29
Glossary.....	31

Introduction

This [risk assessment](#) and surveillance plan provides information to guide decisions regarding chronic wasting disease (CWD) sampling in New York State. Chronic wasting disease is in the family of diseases known as transmissible spongiform encephalopathies (TSE). It is caused by a [prion](#), an infectious protein particle. Once CWD is established on the landscape, there is little chance of elimination, and management of CWD in some states has proven challenging and costly.

In New York, native white-tailed deer (*Odocoileus virginianus*) and moose (*Alces alces*) are at risk for contracting CWD. Surveillance for the disease in New York began in 2002 and, at this time, CWD has not been detected in the state since 2005. However, CWD has been detected in the bordering state of Pennsylvania (2012). The nearby states of Ohio (2014), Maryland (2010), Virginia (2009), and West Virginia (2005) have all found CWD in captive and/or wild white-tailed deer.

From our experience in the 2005 outbreak and resulting intensive surveillance efforts, New York State Department of Environmental Conservation (NYSDEC) is well aware that, though difficult, costly, and not certain, local eradication of CWD may be possible before the disease becomes established, if it is detected soon after introduction while prevalence is low and spread in the wild population is limited. New York is the only state to have had an initial outbreak of CWD and contained it without further detections. Therefore, at this time, optimizing the sampling effort for early detection is the primary goal of surveillance in New York. To detect the disease as early as possible, surveillance should be focused geographically where the greatest introduction [risks](#) are located and in demographic classes in which the disease is most likely to be detected.

This report is the outcome of a collaboration between NYSDEC and the Cornell Wildlife Health Lab (CWHL) to assess potential risks of CWD introduction and spread and to develop a surveillance plan for the state.

This report:

- 1) provides an overview of the disease and its natural history;
- 2) describes the potential consequences should the disease be introduced;
- 3) summarizes past surveillance efforts in New York;
- 4) assesses the risk of CWD introduction into the state; and
- 5) prescribes a risk-weighted surveillance approach to determine sampling effort.

The risk assessment was developed to determine the factual basis of threats associated with CWD introduction into New York through a systematic evaluation of potential [hazards](#) (activities or situations that could introduce or distribute CWD), including activities conducted by taxidermists, meat processors, [captive cervid facility](#) owners, and neighboring states. As part of the risk assessment, a risk perception survey of NYSDEC biologists was completed. This survey was used to evaluate the relative risks for CWD introduction posed by activities conducted within New York and the conditions and activities in surrounding states.

Based on the outcome of the risk assessment, a surveillance plan that focuses on geographic areas with the highest perceived risks was developed. The surveillance plan also incorporates a weighted surveillance method (Walsh et al. 2012, Heisey et al. 2014, Jennelle et al. 2018) to further focus sampling efforts on sex and age classes of white-tailed deer in which CWD is most likely to be first detected,

thereby increasing sampling efficiency and improving the chance of detecting the disease as early as possible. By using a weighted method in which sampling is proportionately distributed based on risk, the plan maximizes sampling efficiency and optimizes resource allocation.

This plan utilizes a CWD Surveillance Database in Microsoft Access currently in use by NYSDEC. The database provides functionality for managing CWD surveillance-related data, executing the hazard model to generate county-level sampling quotas, and reporting progress towards these quotas. An overview of the data collected during the risk assessment and the processes required to generate the annual sampling quota appears in [Figure 1](#).

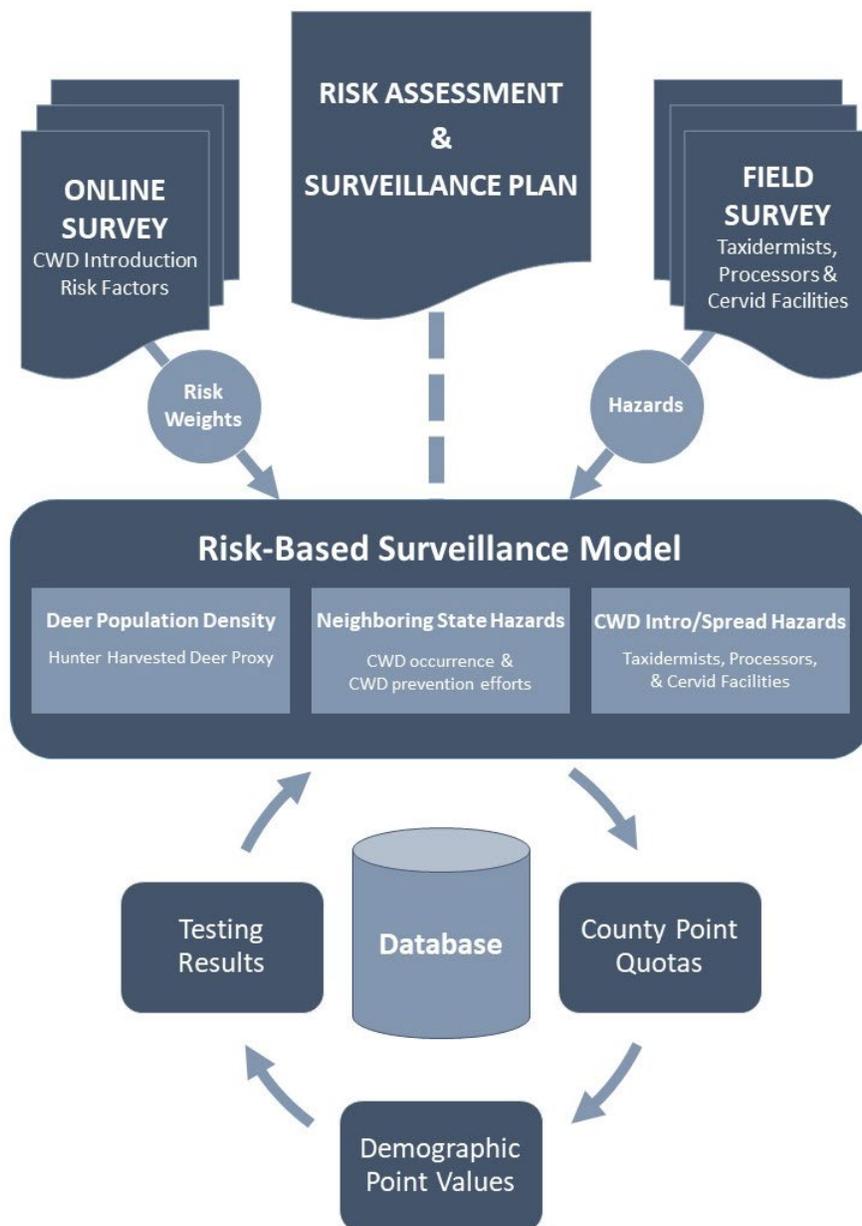


Figure 1. Workflow diagram for New York State Department of Environmental Conservation’s risk-based CWD surveillance system.

CWD Background

Chronic wasting disease is in the family of diseases known as transmissible spongiform encephalopathies (TSE). It is caused by a prion or infectious protein particle. Other TSEs include scrapie in sheep, bovine spongiform encephalopathy or “mad cow” disease in cows, and Creutzfeldt-Jakob disease in humans. Chronic wasting disease is the only known TSE of free-ranging species. First identified in a wildlife research facility at Colorado State University in 1967, CWD has subsequently spread to 27 states and four Canadian provinces in both free-ranging and captive cervids (Figure 2). Some of the more recent detections have come from the eastern United States region, including in wild white-tailed deer in North Carolina, Louisiana, and Alabama in 2022; wild white-tailed deer in Ohio in 2020; wild white-tailed deer in Tennessee and Mississippi in 2018; wild elk and white-tailed deer in Arkansas in 2015; captive white-tailed deer in Pennsylvania in 2012 and wild white-tailed deer in 2013; captive white-tailed deer in Missouri in 2010 and wild white-tailed deer in 2012; and wild white-tailed deer in Maryland in 2010, Virginia in 2009, and West Virginia in 2005.

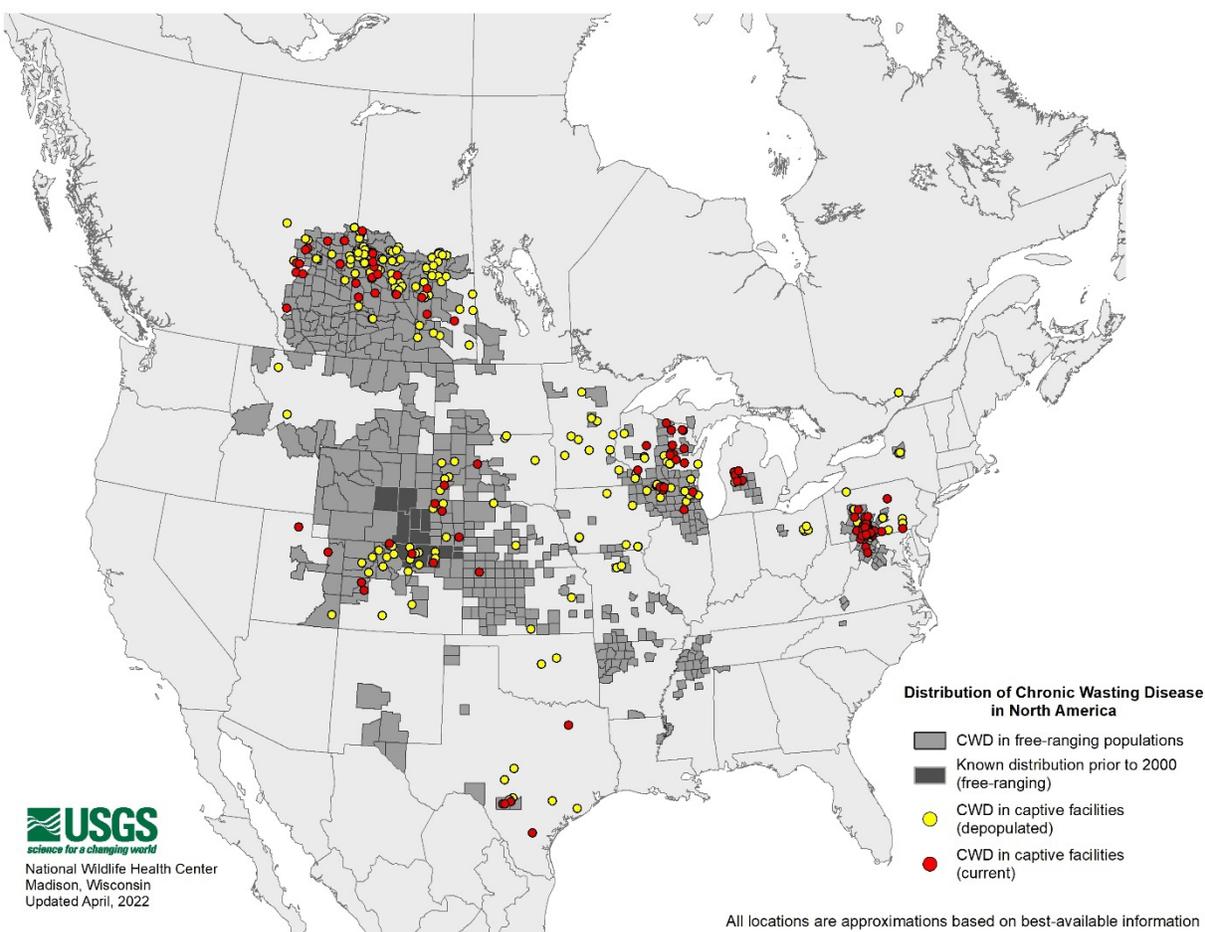


Figure 2. Current known distribution of chronic wasting disease in North America updated April 1, 2022. (Credit: Bryan Richards, USGS National Wildlife Health Center. Public domain. Acquired from USGS website on August 23, 2022. <https://www.usgs.gov/media/images/distribution-chronic-wasting-disease-north-america-0>.)

White-tailed deer, mule/black-tailed deer (*O. hemionus*), elk (*Cervus canadensis*), red deer (*Cervus elaphus*), moose (*Alces alces*), and reindeer/caribou (*Rangifer tarandus*) are the North American species that are naturally susceptible to CWD. Population-level impacts have been demonstrated in white-tailed deer, mule deer, and elk. In a Wyoming white-tailed deer study, Edmunds et al. (2016) estimated 42% prevalence in females and 28% prevalence in males. In this population, CWD-positive deer were 4.5 times more likely to die annually, and these deer also were overrepresented in the hunter harvest. This population was declining at 10% annually. Estimates indicate that population declines are likely to begin once the prevalence rate reaches 27%. A similar study of Wyoming mule deer showed that males had higher prevalence rates (50%) than females (30%), which is typical of most CWD-endemic areas (DeVivo et al. 2017). The population in this study is declining at 19% annually. Elk disease dynamics appear to be slower than those of white-tailed and mule deer. Monello et al. (2014) found an 8% prevalence in elk with a stable population, but the population was expected to decline if prevalence exceeded 13%.

Animals acquire infection through direct contact with other infected animals or indirectly through contact with prions in the environment (Almberg et al. 2011). Animals may begin to shed prions in fluids as soon as three months after becoming infected (Plummer et al. 2017). Prions have been detected in urine, feces, and saliva. Once in the environment, prions are able to bind to the soil and increase infectivity (Johnson et al. 2006). Limited studies have shown prion persistence in the soil for up to 16 years (Georgsson et al. 2006). Prions can also be taken up in plant tissues where they remain infectious (Pritzkow et al. 2015). There is currently no known method for environmental decontamination or animal treatment. Chronic wasting disease is always fatal. There has not been any demonstrated genetic resistance to disease; rather, there have been animals who have shown extended infection times. Similarly, vaccination trials have been largely unsuccessful (Wood et al. 2018).

Humans are not known to be susceptible to CWD. However, the similarity between CWD and other transmissible spongiform encephalopathies (e.g., “mad cow” disease) that have infected humans demands a level of caution. Recent unpublished animal studies suggest CWD can infect non-human primates from consumption of meat from CWD-infected animals. Therefore, the Centers for Disease Control and Prevention (CDC) recommends that no one consume a known CWD-positive animal.

CWD Impacts for New York

Management for [wildlife health](#) contributes in at least two ways to wildlife resource management as a public trust activity. First, it preserves the quality and quantity of trust assets (wildlife resources) for future generations. Secondly, to deliver benefits from trust management, agencies must include reduction of negative impacts associated with wildlife, whether these are perceived or real risks (Decker et al. 2016).

Chronic wasting disease has the potential to diminish the quality of the trust assets, because diseased animals are not as valuable as a trust resource. Hunters and the public are told not to consume sick animals, and decreased hunter participation has been documented in endemic areas. Hunters in several states indicated that they would not be as likely to participate in recreational activities if CWD had been found in the local deer herd (Needham et al. 2006).

A CWD outbreak would also put a severe financial strain on government agencies, not only from the lost revenue from license sales and associated federal funding, but also by redirecting financial and personnel resources (Bishop 2004). The estimated cost to NYSDEC in managing the CWD outbreak in

2005 was over \$1 million (NYSDEC et al. 2018). State agencies may face opposition to disease management activities, which then hinders their abilities to operate effectively as trust managers (Needham and Vaske 2008). Mistrust of the agency and lack of cooperation from the public can bleed into other initiatives and activities. Hunting, as a tool for managing deer populations, could also be impacted, and revenue from license sales could be significantly diminished. Chronic wasting disease activities should be considered not only from a biological perspective, but also from the social, economic, and ecological impacts.

Economic Value of Wild Deer Herd

Wildlife resources are often difficult to commodify. Expenditures by hunters include direct revenue gained from license sales and indirect economic input from retail sales, salaries and wages, and taxes. The white-tailed deer is the most popular game animal in New York with more than 500,000 hunters contributing almost \$1.5 billion annually to the state's economy (NYSDEC et al. 2018). NYSDEC receives more than \$35 million each year for management activities from hunting-related expenses such as license fees and federal taxes (NYSDEC, <https://www.dec.ny.gov/animals/6965.html>). More than 200,000 deer are typically harvested by hunters each year in New York resulting in an estimated 10.8 million pounds of venison for consumption (NYSDEC, <https://www.dec.ny.gov/animals/6965.html>). If CWD were to be found again in New York, deer hunting activity and revenue would likely decline and affect the economy of the state (Bishop 2004, Haus et al. 2017, Koblinsky 2018, Needham et al. 2006), particularly in rural areas. All of these benefits and economic contributions are likely to be impacted with detection of CWD.

Risk Assessment

The purpose of this CWD risk assessment for New York is to document and describe potential sources or causes of CWD introduction, referred to as hazards, into New York. The risk assessment is limited to hazards identified by past studies as potential avenues for CWD introduction. However, the risk assessment is also limited to hazards for which data already exist or could be collected through the risk assessment process. For instance, although illegal transport of cervid carcasses or parts from CWD-positive areas into New York may potentially occur, no data that quantify this hazard are available. Because New York currently has no recent CWD occurrences in its wild or captive cervid populations, the risk assessment includes potential hazards that exist due to activities and conditions in neighboring states, as well as hazards that exist within New York.

Outside New York

To understand potential CWD introduction risks from neighboring areas, we reviewed conditions and activities related to white-tailed deer and CWD in 14 eastern US states.

New York is bordered by five states, one of which, Pennsylvania, has found CWD in both its captive (2012) and wild (2013) white-tailed deer populations ([Table 1](#)). Recent detections of CWD in captive white-tailed deer in 2021 in Warren County, Pennsylvania within 5 miles of the border raise the risk for CWD introduction into New York. A road-killed wild white-tailed deer was detected in Jefferson County, Pennsylvania in 2021 as well. Pennsylvania has established six disease management areas (DMA) across the state. Chronic wasting disease has previously been detected in wild white-tailed deer in several nearby states, including Ohio (2020), Maryland (2010), Virginia (2009), and West Virginia (2005). These

outbreaks present obvious CWD introduction hazards due to natural deer movement along New York's southern border or a long-distance movement event.

Surveillance Programs in Neighboring States

Undetected CWD outbreaks or spread from known CWD-positive areas are potential sources for disease introduction into New York. Therefore, the effectiveness of surveillance programs administered in neighboring states is relevant to New York's early detection and response efforts. For New York, more effective surveillance of the wild cervid population in neighboring states means a reduced risk of CWD introduction from undetected CWD occurrences. Therefore, CWHL has been working with numerous eastern states through the Surveillance Optimization Project (<https://cwhl.vet.cornell.edu/project/sop4cwd>) to improve and standardize states' surveillance and data sharing abilities. Chronic wasting disease surveillance programs throughout the region vary in terms of why and how samples are collected, the sources of those samples, and where those samples are collected (Table 1). Programs that sample wild cervids in areas in which the disease has not yet been found, primarily in areas at greatest risk for introduction, and test a statistically justifiable number of samples annually are likely to be most effective at early detection.

Regionally, there are six states that sample more than 1,000 wild cervids annually. The bordering state of Pennsylvania tests large numbers of deer each year and is in the process of adopting a risk-weighted statewide active surveillance program.

Movement of Cervid Carcasses or Parts

Importation of carcasses or trophy heads from out-of-state represents a high risk for CWD introduction due to the potential for CWD-positive remains to be discarded on the landscape. New York has banned whole carcass importation from all states, regardless of CWD status. Eight states in the region also prohibit importation of carcasses from all states; the remainder prohibit whole carcass importation from CWD-positive states only (Table 2).

Feeding & Baiting

Concentrating animals around a food source is known to enhance disease transmission, and therefore, may facilitate transmission of CWD prior to detection by limited surveillance. Feeding and baiting are allowed, or allowed with some restrictions, in most states in the region (Table 2).

Captive Cervid Facilities

Long distance spread of CWD within and between states has been associated with the transfer of captive cervids between captive cervid facilities. Introduction of CWD to the wild cervid population has also been associated with CWD introductions at captive cervid facilities. Therefore, activities associated with captive cervid facilities, particularly transfers between facilities, may create CWD introduction hazards within New York or in neighboring states.

Of the eastern states reviewed, only Pennsylvania allows importation of all live captive cervids (Table 2). Kentucky, Indiana, Ohio, and West Virginia restrict live imports to those from CWD-negative states or CWD-certified herds. Illegal activities, such as unapproved movement or release of live cervids (Tidd 2018), has occurred from CWD-positive herds (Fitzgerald 2017). However, it was not feasible to assess this factor within the scope of this risk assessment.

RISK-WEIGHTED SURVEILLANCE FOR CHRONIC WASTING DISEASE IN NEW YORK

High-fence shooting operations are permitted in eight states in the region, although Vermont prohibits housing white-tailed deer and moose in hunting enclosures.

While we recognize the coarse scale of these metrics, they can be helpful for directing surveillance efforts in the absence of other information. This assessment is not a comment on other states' practices or situations, but rather a suggestion for NYSDEC on where to focus surveillance efforts.

Table 1. CWD status and surveillance activities in the eastern US (* = state neighbors New York).

State	CWD status	Wild cervid annual testing volume	Surveillance method	Sample source		
				Clinical suspects	Road-kill or other opportunistic sources	Hunter-harvested animals
Connecticut*	Not detected	<1,000	Statewide	Statewide	Statewide	Statewide
Delaware	Not detected	<1,000	Statewide			Statewide
Indiana	Not detected	<1,000	Statewide	Statewide	Statewide	Statewide
Kentucky	Not detected	1,000-4,999	Statewide	Statewide	Statewide	Statewide
Maryland	Detected	<1,000	Statewide	Statewide	Statewide	CWD zone
Massachusetts*	Not detected	<1,000	Statewide	Statewide		
New Jersey*	Not detected	<1,000	Statewide	Statewide		Statewide
New York	Not detected	1,000-4,999	Risk-based weighted sampling	Statewide	Statewide	Statewide
Ohio	Detected	1,000-4,999	Statewide	Statewide	Statewide	Statewide
Pennsylvania*	Detected	>10,000	Statewide	Statewide	Statewide	Statewide
Rhode Island	Not detected	<1,000	Statewide	Statewide	Statewide	Statewide
Vermont*	Not detected	<1,000	Statewide	Statewide	Statewide	Statewide
Virginia	Detected	1,000-4,999	Statewide focused on older bucks		CWD zone	CWD zone
W. Virginia	Detected	1,000-4,999	Statewide goals		Statewide	CWD zone

RISK-WEIGHTED SURVEILLANCE FOR CHRONIC WASTING DISEASE IN NEW YORK

Table 2. Activities associated with CWD introduction risk in eastern states, including if feeding or baiting is permitted anywhere in the state, if whole carcasses are permitted to be imported from non-CWD-positive states, and if the state allows importation of live captive cervids. Conditional indicates the activity is allowed only under specific guidelines. (* = state neighbors New York)

State	Baiting	Feeding	Whole carcass importation	Live captive cervid importation	Intrastate live cervid movement	Cervid facilities	Hunting enclosures
Connecticut*	Conditional	Allowed	Prohibited	Prohibited	Prohibited from CWD-positive areas	Allowed	Do not exist
Delaware	Conditional	Allowed	Allowed from CWD-negative states only	Prohibited	Allowed	Prohibited (with the exception of grandfathered facilities)	Prohibited
Indiana	Prohibited	Allowed	Allowed from CWD-negative states only	Prohibited from CWD-positive states	Allowed	Allowed	Allowed
Kentucky	Conditional	Conditional	Prohibited	Allowed from CWD certified herds	Prohibited	Allowed	Allowed
Maryland	Conditional	Conditional	Allowed from CWD-negative states only	Prohibited	Prohibited	Prohibited	Prohibited
Massachusetts*	Conditional	Allowed	Allowed from CWD-negative states only	Prohibited	Allowed	Prohibited (limited to sika and fallow deer, 3 grandfathered)	Prohibited
New Jersey*	Allowed	Allowed	Prohibited	Prohibited	Allowed	Allowed	Allowed
New York	Prohibited	Conditional	Prohibited	Prohibited	Allowed	Allowed	Allowed
Ohio	Allowed	Allowed	Prohibited	Allowed from CWD certified herds	Allowed	Allowed	Allowed
Pennsylvania*	Conditional	Conditional	Prohibited	Allowed	Allowed	Allowed	Allowed
Rhode Island	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited
Vermont*	Conditional	Prohibited	Allowed from CWD-negative states only	Prohibited	Allowed	Prohibited	Allowed (WTD and moose prohibited)
Virginia	Prohibited	Conditional	Prohibited	Prohibited	Prohibited	Prohibited (with the exception of grandfathered facilities)	Prohibited
W. Virginia*	Conditional	Conditional	Allowed from CWD-negative states only	Allowed from CWD certified herds	Allowed from CWD-negative areas only	Allowed	Allowed

Inside New York

Meat Processors and Taxidermists

To assess risks of CWD introduction and spread within New York, we developed a risk survey for meat processors and taxidermists to identify locations and quantify potential hazards. Taxidermy and meat processing operations are not regulated by New York State. Therefore, a list of these facilities was

created by searching informal lists pertaining to sources of venison donation, previous CWD cooperators or research participants, internet search results, and NYSDEC staff knowledge. In 2012 and 2017, NYSDEC staff attempted to contact and interview all meat processors and taxidermists via phone or in-person visits.

We used the survey data from taxidermists and meat processors to gauge hazards from imported carcasses and parts, but this information does not include individual hunters who may process their animals at home. Of the 898 businesses identified ([Table 3](#)), 205 were known to be closed or could not be contacted and assumed closed. In total, 443 taxidermists, 400 meat processors, and 24 taxidermists/processors were successfully contacted for interviews for a 97% response rate.

Table 3. Response by business type to determine CWD-associated risks with activities. Licensed taxidermists and meat processors were contacted. They were not included in the risk assessment if they were no longer in business or did not handle white-tailed deer.

Business Type	Total number of businesses	Number of completed surveys	Number not in business	Survey completion rate
Taxidermist	452	443	67	98%
Processor	422	400	134	95%
Taxidermist/ Processor	24	24	4	100%
Total	898	867	205	97%

The number of operating taxidermists and processors varied across the regions with the highest densities in Regions 7 and 8 ([Figure 3](#), [Table 4](#)). Only eight of these businesses also had live captive cervids on the premises; [6NYCRR 189.8](#) prohibits taxidermy of CWD susceptible animals imported into New York and possession of captive cervids on the same premises. Detections of CWD in New York and Minnesota involved business proprietors mixing taxidermy and live cervids. However, 18% (119/667) of taxidermists and meat processors received deer parts from outside of New York ([Table 5](#)). Distribution of deer parts on the landscape is a potential route of CWD introduction. From the risk assessment, it appears that only 5% (36/667) of taxidermists and meat processors use high-risk disposal methods, such as open pits, composting, or discarding on the ground, that could leave prions on the landscape ([Table 5](#)).

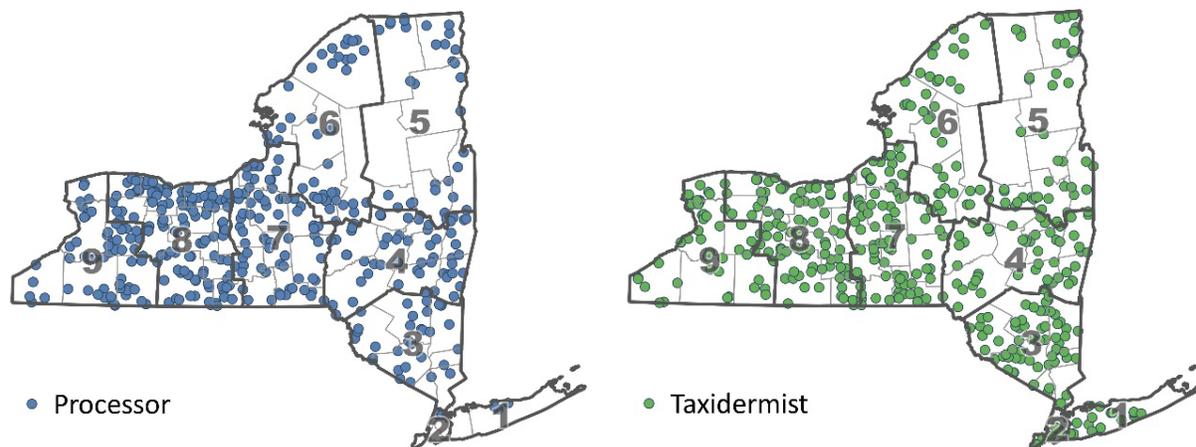


Figure 3. Locations of meat processors and taxidermists in New York with counties and regions outlined in black. Numbers indicate NYSDEC regions.

Table 4. Distribution across NYSDEC regions of taxidermists and meat processors in business in 2020.

	REGION									Statewide
	1	2	3	4	5	6	7	8	9	
Counties	2	5	7	9	8	5	9	11	6	62
Square kilometers	7,321	1,213	12,346	16,147	25,105	22,492	17,541	21,468	17,663	141,296
Taxidermist	16	6	50	46	45	30	78	73	41	385
Processor	3	1	21	40	25	28	50	81	39	288
Taxidermist/ Processor	4	0	1	2	0	0	3	8	2	20
Total	23	7	72	88	70	58	131	162	82	693

RISK-WEIGHTED SURVEILLANCE FOR CHRONIC WASTING DISEASE IN NEW YORK

Table 5. Practices of taxidermists and meat processors by region and statewide that have live captive cervids on their premises and/or handle deer carcasses harvested from outside New York.* High-risk disposal methods include on premises deposition in open pits, composting, left on property in a manner potentially exposing other animals to remains, or fed to other animals. Low-risk disposal methods include disposal in a landfill, rendering or incineration, or returning remains to the hunter.

Business type	Region	Interviewed				
		open businesses	Live captive cervids	Deer from out-of-state	High-risk disposal	Low-risk disposal
Taxidermists	1	16	0	2	0	2
	2	6	0	0	0	0
	3	50	1	21	2	22
	4	45	3	0	1	2
	5	44	0	1	0	1
	6	30	0	16	3	15
	7	78	1	11	2	18
	8	69	2	11	1	11
	9	38	0	13	2	14
	Statewide	376	7	75	11	85
Meat Processors	1	3	0	0	0	1
	2	1	0	0	0	0
	3	18	0	8	1	10
	4	40	0	3	6	27
	5	22	1	0	1	3
	6	28	0	8	1	15
	7	49	0	8	3	35
	8	77	0	8	7	40
	9	33	0	4	6	16
	Statewide	271	1	39	25	147
Taxidermists/Meat Processors	1	4	0	1	0	2
	2	0	0	0	0	0
	3	1	0	0	0	0
	4	2	0	0	0	0
	5	0	0	0	0	0
	6	0	0	0	0	0
	7	3	0	3	0	3
	8	8	0	0	0	2
	9	2	0	1	0	2
	Statewide	20	0	5	0	9
All	Statewide	667	8	119	36	241

* Current CWD Regulations in [6NYCRR 189.8](#) were passed in 2019, after this survey was conducted. Prohibitions include taxidermy of CWD-susceptible animals imported into New York and possession of captive cervids on same premises. Meat processors are not prohibited from possessing live captive cervids.

This assessment did not include individual hunters who process their own animals. Although the practices and activities of these individuals could not be assessed, some activities may pose potential hazards. For instance, disposal would be a concern if carcass parts are discarded on the landscape, allowing other animals to be exposed to potentially CWD-positive tissues or contaminated soils or plants (Pritzkow et al. 2015). Additional studies with the Cornell Center for Conservation Social Science are currently in progress to elucidate hunter behavior related to disposal and travel habits.

Captive Cervid Facilities

We also evaluated captive cervid facilities in the state ([Figure 4](#)). Captive cervid facilities that contain white-tailed deer are licensed through NYSDEC and are inspected and enrolled in CWD herd certification programs by the NYS Department of Agriculture and Markets. Licensed facilities must submit annual reports to NYSDEC documenting numbers of animals acquired, sold, harvested, found dead, escaped, and tested for CWD. All movements to other facilities require the facility operator to obtain a transport permit from NYS Department of Agriculture and Markets indicating the deer that are being moved, when they are being moved, and to where they are being moved.

Of the 290 known licensed captive cervid facilities, excluding zoos, not listed as closed and for which data was available in 2021 (n=133), 78 had only white-tailed deer, 1 had only red deer, 2 had only reindeer, 33 had only fallow deer, and 17 had multiple cervid species. About 71% (95/133) of these facilities have white-tailed deer, elk, red deer, or reindeer that are known to be naturally susceptible to CWD. Reindeer have just recently been shown to be naturally susceptible to CWD (Benestad et al. 2016) but are not being included in the USDA CWD Herd Certification Program Standards at this time.

Seventeen of these facilities deal in live interstate transport of deer, 13 are reported to be non-compliant with regulations, and 27 have shooting operations. While numbers were not available to adequately assess most of these facilities, it appears that a small fraction have inadequate fencing that may allow ingress and egress of deer. At the time of the survey, forty of these businesses also had taxidermy or meat processing activities on-site; these may represent a higher CWD introduction risk due to the potential for transfer of prions between wild carcass parts brought in and live cervids.

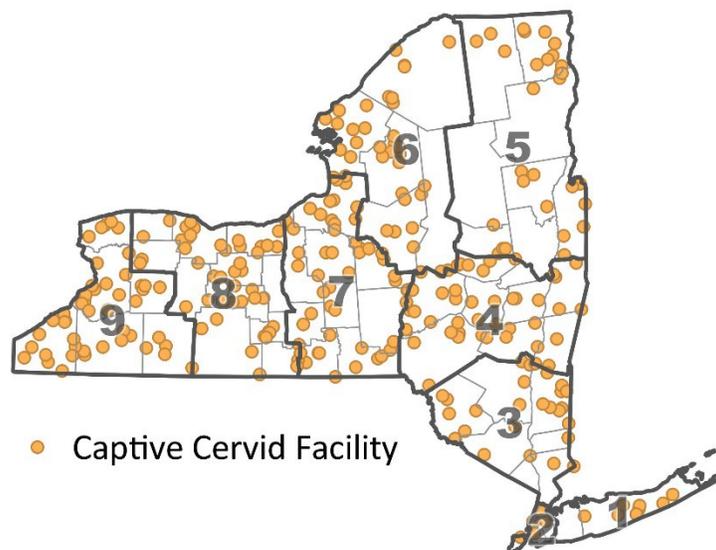


Figure 4. Locations of captive cervid facilities in New York with counties and regions outlined in black. Numbers indicate NYSDEC regions.

NYSDEC Risk Perception Survey

NYSDEC biologists and wildlife management staff were surveyed in 2012 and again in 2021 to assess perceived risks of CWD introduction into New York due to identified hazards. These risk factors were characterized as negligible, low, medium, or high risk in an online survey administered through Qualtrics survey software (Qualtrics, Provo, UT, USA. <https://www.qualtrics.com>). The risk factors included in the survey corresponded with variables collected for potential hazards within New York, as well as extrinsic factors, such as the occurrence of CWD in a neighboring state. The risk factors were converted to numeric values (negligible=0, low=1, medium=2, and high=3) (Table 6).

RISK-WEIGHTED SURVEILLANCE FOR CHRONIC WASTING DISEASE IN NEW YORK

Table 6. Results of risk perception survey of CWD introduction hazards associated with business practices of taxidermists, meat processors, and captive cervid facilities and conditions in adjacent states. Risks were assessed and quantified by NYSDEC biologists through the Qualtrics survey. Risk factors were converted to numeric values with negligible risk=0, low risk=1, medium risk=2, and high risk=3.

Hazard by location	Average risk	Standard deviation
Taxidermists and meat processors		
Number of deer handled annually		
0-10 deer	0.67	0.72
10-100 deer	1.60	0.82
>100 deer	2.53	0.74
Disposal method leaving carcasses/parts available to wild deer or elk	2.27	0.70
Hunter-harvest cervid parts coming in from out of state	2.40	0.63
Additional activities on premises		
Wild deer rehabilitation	2.53	0.83
Captive cervid facilities		
Possession of CWD-susceptible species	2.00	0.76
Disposal method of carcasses/parts that is available to wild deer or elk	2.47	0.64
Owner is not in compliance with regulations	2.87	0.35
Fence quality		
High - 8' and no breaches	1.33	0.82
Medium - Mostly 8' and questionable escapability	2.26	0.59
Low - not maintained to an acceptable standard	3.00	0
Additional activities on premises		
Deer processing	2.20	0.77
Taxidermy	2.33	0.82
Wild deer rehabilitation	2.47	0.92
High fence shooting operation	2.20	0.68
Adjacent states		
Detection of CWD	2.80	0.41
Presence of captive cervid facilities	2.60	0.63
Permitted import of live captive cervids	2.80	0.41
Permitted high-fence shooting operations	2.27	0.70
Low level CWD surveillance (<1,000 samples/year)	2.40	0.63

Surveillance Plan

Past surveillance efforts

New York has been conducting routine CWD surveillance since 2002 and has tested more than 60,000 samples ([Table 7](#)). Early on, NYSDEC collected most samples for CWD testing from hunter-harvested deer provided by meat processors. In 2005, CWD was detected in five captive white-tailed deer in two captive cervid facilities in Oneida County. In response, the affected captive herds were depopulated. NYSDEC established a containment area around the cervid facilities and undertook extensive culling and testing of deer in the area. Two wild white-tailed deer were found to be infected. Since 2005, no additional cases of CWD have been detected in captive or wild white-tailed deer in New York and the containment area was eliminated in 2010.

Since 2013, the risk-weighted surveillance method presented in this plan has been used to determine county goals for CWD testing; sampling quotas are based on relative risks, including deer density, captive cervid facilities, and proximity to CWD-positive states.

Table 7. Previous CWD surveillance of white-tailed deer (WTD) in New York.

Season	Number of WTD tested for CWD
2002-2003	1,194
2003-2004	988
2004-2005	551
2005-2006	8,166
2006-2007	7,907
2007-2008	7,473
2008-2009	2,971
2009-2010	2,682
2010-2011	1,792
2011-2012	1,806
2012-2013	1,572
2013-2014	2,523
2014-2015	2,346
2015-2016	2,457
2016-2017	2,596
2017-2018	2,407
2018-2019	2,374
2019-2020	2,817
2020-2021	2,705
2021-2022	2,967
Total	60,518

Weighted Surveillance

The probability of CWD detection in the free-ranging deer population can vary due to a number of factors including the age and sex of the deer population segments sampled, as well as the sample source (hunter-harvested, roadkill, clinical suspect, etc.). Research in CWD-positive states has identified older

males as being more likely to have CWD than females or younger males. In addition, males are considered a better surveillance sample in most systems because of their large home ranges and behaviors including co-mingling with other males during the non-breeding season, close contact with females during the rut, and geophagy (dirt-eating). By assigning sample weights or “points” to an animal based on its value for detecting disease, we improve the information gathered per sample over a randomized collection process (Heisey et al. 2014, Jennelle et al. 2018). Therefore, this approach can improve the statistical assurance of freedom from disease with fewer tests.

Sample weights have not been calculated for New York or any other state in the eastern US. NYSDEC may choose to develop state-specific surveillance weights and can adjust sampling efforts accordingly in the future. For this plan, we adapt surveillance weights developed for Wisconsin wild white-tailed deer (Jennelle et al. 2018) ([Table 8](#)).

For ease of implementation, assigned point values for each age/sex segment are rounded to the nearest half-point. This small adjustment has a negligible effect on actual quotas, but significantly eases interpretation. A buck that is 2.5 years or older at time of harvest is worth 3 points while a yearling buck is worth 1 point; thus, an adult buck is three times more valuable a sample as a yearling buck. A doe that is 2.5 years or older at time of harvest is worth 1.5 points while a yearling doe is only 1 point. Therefore, the surveillance program objective is to actively seek older bucks and does for sampling to increase the probability of early disease detection. Fawns are excluded from the point tally because of the low probability of disease detection in this age class. Samples from adult deer of unknown sex are counted as 1.5 point, and yearling deer of unknown sex are counted as 1 point based on minimum values for those age classes. Samples from deer of unknown age are not counted toward point quotas as their value cannot be accurately assessed.

For this plan, in contrast to the point scheme proposed by Jennelle et al. (2018), point values will not vary by sample source (hunter harvest, vehicle collision, found dead, sharpshooting, or reported abnormal). There is anecdotal evidence from eastern states (e.g., Pennsylvania, Virginia, and West Virginia) that vehicle collisions are a more valuable surveillance sample than Wisconsin data may indicate. However, because sample weights have not been determined for any states in the eastern US, sample weights will be the same within an age-sex population segment for all potential sample sources.

Table 8. Modeled weights for sex and age classes of hunter-harvested animals (Jennelle et al. 2018). Surveillance point values are simplified weights to meet county point quotas and may come from any source (hunter harvest, vehicle collision, found dead, or clinical suspects).

Sample	Hunter-harvested deer's	
	weighted value	Surveillance points
Adult Male (≥ 2.5 yrs)	3.237	3
Adult Female (≥ 2.5 yrs)	1.328	1.5
Yearling Male (1.5 to < 2.5 yrs)	1	1
Yearling Female (1.5 to < 2.5 yrs)	0.877	1

Statewide Point Quota

An objective of this surveillance plan is to collect sufficient points statewide to allow detection of at least one case of CWD with 95% confidence if the prevalence in yearling males (the reference class for comparison) is 1%. To achieve this goal, the statewide sampling quota should be set at 2,994 points or approximately 3,000 points (<https://popr.cfc.umt.edu/CWD/>). Because NYSDEC has the resources available to collect more points, the annual statewide point quota for New York is currently set at 4,000 points, with 500 additional points allocated to Chautauqua (300) and Cattaraugus (200) counties because of the proximity of a CWD-positive detection in Pennsylvania. The CWD Surveillance Database can be used to recalculate sampling quotas if resources or needs change.

It is important to recognize that 100% confidence in the ability to detect CWD at any prevalence cannot be achieved due to the nature of sampling. Chronic wasting disease outbreaks in Arkansas and Tennessee have shown that CWD can exist undetected for a period of time allowing it to rise to a significant local prevalence level before being detected. Furthermore, Belsare et al. (2020) demonstrated that heterogeneities resulting from spatial clustering of disease or non-random sampling associated with hunter harvest could significantly increase the sampling required to detect disease at 1% prevalence.

During the 2020-2021 sampling period, 2,705 samples from white-tailed deer were collected by NYSDEC, which was equivalent to 5,017 points (Table 9). Based on surveillance collection efforts by NYSDEC in 2020-2021, sex and age demographics demonstrate that a statewide average of 4,500 or more points annually is feasible.

Table 9. Surveillance points from deer sampled in the 2020-2021 season in New York.

2020-2021	Male		Female		Unknown		Total	
	Deer	Points	Deer	Points	Deer	Points	Deer	Points
Adult	1,122	3,366	808	1,212	4	4	1,934	4,582
Yearling	305	305	127	127	3	3	435	435
Fawn	191	0	140	0	1	0	332	0
Unknown	1	0	2	0	1	0	4	0
Total	1,619	3,671	1,077	1,339	9	7	2,705	5,017

County Point Quotas

To maximize the chance of early detection, sampling effort should be distributed geographically based on the CWD introduction risk. Areas with higher risk of disease introduction should have more intensive surveillance. Therefore, the annual statewide point quota is distributed proportionately based on risk by county, the smallest sampling unit for the state.

Each county is scored using two metrics: 1) a hazard risk score (risk of CWD introduction due to human activities) and 2) a demographic risk score (risk of introduction due to spread within the free-ranging deer population). The total point sample quota of 4,000 points is divided approximately 2:1 between these metrics, with 2,500 sampling points distributed based on hazards (the hazard risk score) and 1,500 sampling points distributed based on a demographic metric (the demographic risk score).

Hazard Risk Score

The hazard risk score is calculated per county as the sum of all risk-weighted hazards for that county. Hazards accounted for in this metric include those found in the risk assessment process, which are the presence and activities of meat processors and taxidermists, presence and activities of captive cervid facilities, and detection of CWD and activities of states adjacent to border counties.

An individual risk score was determined for each taxidermist, meat processor, and captive cervid facility known to be in operation at the time of the risk assessment. Each entity was assigned a base score of one point; extra risk points were added for additional hazards according to the average risk score for that hazard from the risk perception survey described earlier. Risk scores for all entities were summed per county.

For counties bordering other states, if a hazard or risk condition existed in a neighboring state, an additional risk score was calculated ([Table 10](#)). For each condition, the associated risk from the risk perception survey was multiplied by the condition level to determine a condition risk score. The individual risk scores were summed for each county. Due to the perceived risk of CWD introduction resulting from intrinsic versus extrinsic factors and based on information gathered from risk surveys completed for New York, as well as other states, the condition risk scores were scaled up relative to the other hazard risk scores by a factor of 15. The condition risk scores per county are shown in [Figure 5](#). Two thirds of the sampling point quota was distributed based on the total hazard risk score ([Figure 6](#)).

Table 10. Risk factors, weights, and condition values for states neighboring New York counties.

Condition or activity in a neighboring state	Risk perception survey risk weight	Multiplier for condition level		
		0	0.5	1
Detection of CWD	2.65	Not detected	n/a	Detected
Presence of captive cervid facilities	2.53	Prohibited	Allowed only under limited conditions	Allowed
Permitted importation of live captive cervids	2.88	Prohibited	Allowed only under limited conditions	Allowed
Permitted high-fence shooting operations	2.52	Prohibited	n/a	Allowed
CWD-surveillance approach	2.24	Strategic statewide sampling including hunter-harvested animals	Opportunistic sampling of clinical suspects or roadkill samples	Limited or no surveillance

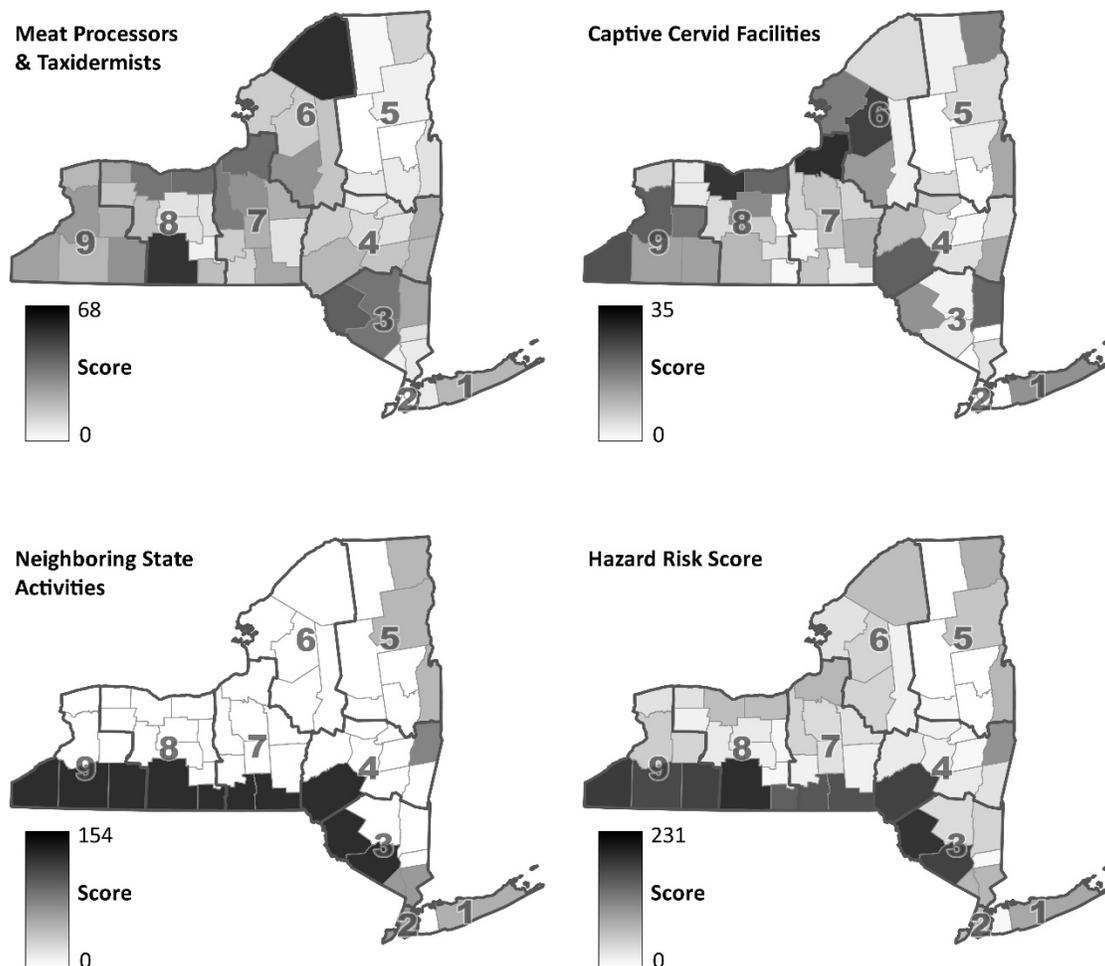


Figure 5. Hazard risk scoring by county. Hazards present within New York and in neighboring states were weighted according to the results of the NYSDEC risk perception survey and aggregated by county. Counties and regions are outlined in black. Numbers indicate NYSDEC regions.

Demographic Score

The purpose of the demographic information is two-fold. First, if the deer population or deer harvest is sufficiently low in certain areas to prevent adequate sampling, the effort needed to acquire desired samples may be logistically infeasible. Second, in higher density deer areas, there is a higher probability of transmission and spread so deer should be sampled more intensively in these areas to ensure that clusters of infection are not missed.

County-level deer population estimates were not available for New York. Therefore, the total number of hunter-harvested deer (deer/mi² x county area) in 2021-2022 was used as an index for deer population per county. One third of the sampling point quota was distributed based on this demographic index (Figure 6).

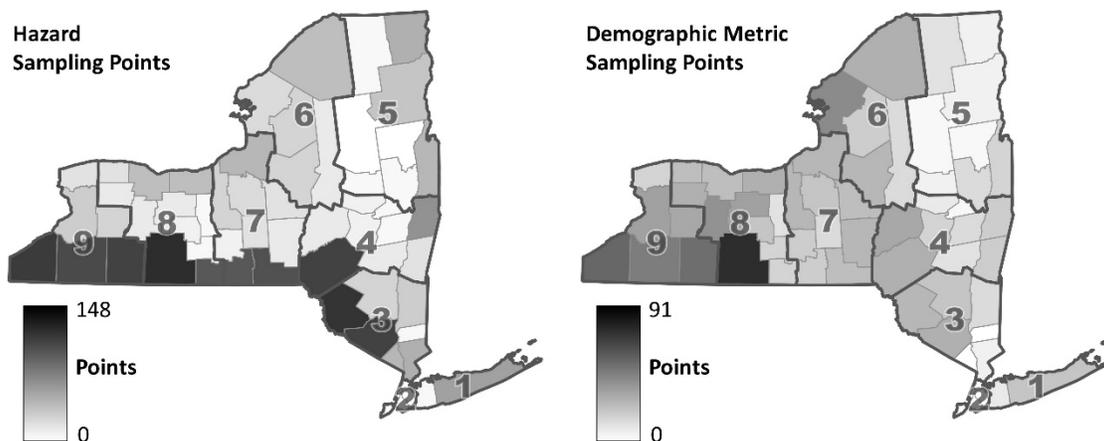


Figure 6. Sampling point quota allocation from hazard scoring and demographic index. Counties and regions are outlined in black. Numbers indicate NYSDEC regions.

County Surveillance Category

The CWD Surveillance Database used to calculate county surveillance quotas allows NYSDEC to designate surveillance goals for specific counties. These surveillance categories are early (first) detection, monitoring, and high-risk (Table 11).

Table 11. Surveillance categories that may be assigned to counties to calculate point quotas.

Surveillance category	CWD status	Goal	Point quota
Early (first) detection	CWD has not been detected in county or neighboring counties.	Detection of new outbreaks of CWD from unknown or long-distance sources.	Proportional allocation based on the accumulation of hazards and deer harvest density.
Monitoring	CWD is present.	Monitoring spread and change in prevalence of CWD.	Determined by agency.
High-risk (buffer/border)	CWD has not been detected in county but exists in neighboring county.	Detection of new outbreaks of CWD resulting from natural movement of infected deer from neighboring areas.	Determined by agency.

In the basic hazard model used for states in which CWD has not been detected, all counties are assigned to the early (first) detection category. Based on CWD detection in counties bordering New York, NYSDEC chose to assign Chautauqua and Cattaraugus counties to the high-risk surveillance category. Counties assigned to these categories are removed from the distribution of the 4,000 point statewide quota based on hazards and deer density. The point quotas for these categories are determined by the agency and can be adjusted each year. For 2022-2023, the high-risk counties of Chautauqua and Cattaraugus were assigned 300 and 200 points, respectively. Consequently, the total statewide point quota will be

greater than 4,000 points according to the number of counties assigned to monitoring and high-risk categories. For 2022-2023, the statewide point quota is 4,500 points. The five counties of New York City (New York, Kings, Bronx, Richmond, and Queens Counties) are excluded from the sample quota calculation because deer hunting is prohibited in these areas.

County Sampling Point Quotas for 2022-2023

The suggested county-level sampling quotas, which are the sum of the hazard sampling points and the demographic metric sampling points for counties in the early detection category or the assigned point values for counties listed as high-risk, are shown in [Figure 7](#) and summarized by region in [Table 12](#).

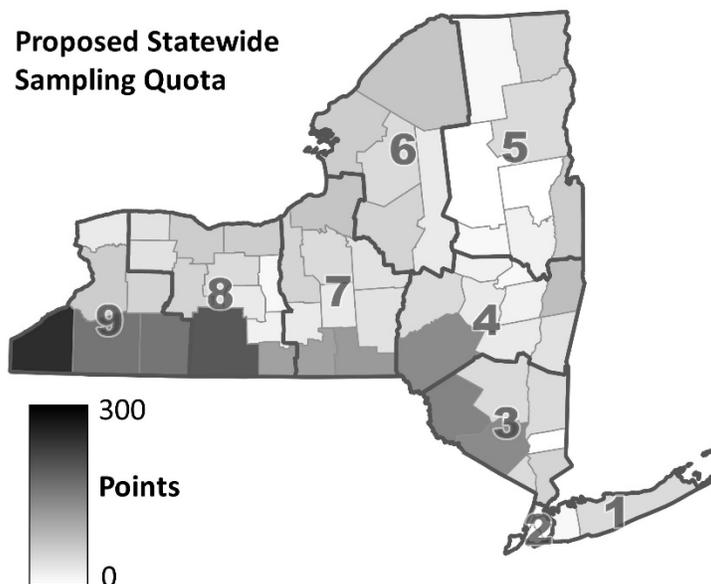


Figure 7. Suggested 4,500 sampling point quota for 2022-2023. Counties and regions are outlined in black. Numbers indicate NYSDEC regions.

Implications and Recommendations for NYSDEC Biologists

Because this CWD surveillance strategy is more targeted and more spatially explicit than past efforts, it is important to note the implications and considerations for NYSDEC biologists as they implement this strategy in their respective regions. The quotas for 2022-2023 are suggested efforts based on the accumulation of hazards, index of deer density, and surveillance goal for each county; however, staffing considerations and the ability to obtain samples may impact reaching these quotas each year.

These quotas can be filled by any source of wild white-tailed deer: hunter-harvest, clinically ill, vehicle collisions, sharpshooting, and found dead. Samples from any escaped captive cervids that are collected and tested should not be included in the point quota. Field staff should receive regular updates on status of county quotas to ensure they can meet goals during the hunting season.

We suggest that point quotas are recalculated with updated information at least every three to five years.

Taxidermist Program

To assist with efforts to increase the volume of CWD samples, programs to incentivize partnerships with taxidermists and meat processors for collection and submission of samples have been successful in New York and other states (Ableman et al. 2019). We recommend leveraging this program early and often, especially in counties that have historically not generated many samples and now have a substantial point quota. We also recommend regular communication with participating taxidermists and/or meat processors to ensure they are not collecting samples from counties where the quota has already been achieved.



RISK-WEIGHTED SURVEILLANCE FOR CHRONIC WASTING DISEASE IN NEW YORK

Table 12. County CWD surveillance sampling quotas by region based on sampling 4,000 points for counties assigned to the early detection surveillance goal. Risk points are proportionally allocated to counties from two sources: the demographic risk score based on the estimated deer density as indexed by deer harvest (1,500 points statewide) and the hazard risk score based on identified hazards (2,500 points statewide). Processor/taxidermist risk score accounts for risks associated with size of operation, importation of cervids, disposal methods, and presence of live cervids. Cervid facility risk score can incorporate risks associated with type of facility, fence quality, operation concerns, and other activities when these become available. Neighboring state conditions risk score incorporates perceived risks associated with practices that may represent a higher risk for CWD introduction with minimal disease surveillance. Risk points are then tallied for each county to define a county sampling quota. Neighboring county conditions risk score is additional points assigned to counties along the New York perimeter that border a CWD-positive state or a state with practices that may represent a higher risk for CWD introduction with minimal disease surveillance. CWD unit points refer to the surveillance goal in a county. They can be set by NYSDEC and used in place of calculated quotas for counties assigned to high-risk or monitoring surveillance categories. Risk points are then tallied for each county to define a county sampling quota.

	Demographic Risk		Hazard Risk					CWD Unit Points	Point Sampling Quota
	Deer harvest	Demographic Risk Points	Processor/Taxidermist Risk Score (number of businesses)	Cervid Facility Risk Score (number of facilities)	Neighboring State Conditions Risk Score	Total Hazard Risk Score	Hazard Risk Points		
Region 1									
Nassau	1,886	11	9.0 (8)	0 (1)	0	9.0	6	0	17
Suffolk	4,525	27	23.0 (19)	17.4 (8)	60	100.4	65	0	53
Total	6,411	38	31.9 (27)	17.4 (9)	60	109.3	71	0	70

	Demographic Risk		Hazard Risk					CWD Unit Points	Point Sampling Quota
	Deer harvest	Demographic Risk Points	Processor/Taxidermist Risk Score (number of businesses)	Cervid Facility Risk Score (number of facilities)	Neighboring State Conditions Risk Score	Total Hazard Risk Score	Hazard Risk Points		
Region 2									
Bronx	0	0	0.7 (1)	0 (0)	73.05	73.7	0	0	0
Kings	0	0	1.3 (2)	0 (0)	73.05	74.4	0	0	0
New York	0	0	0 (0)	5.2 (1)	73.05	78.3	0	0	0
Queens	0	0	1.3 (2)	0 (0)	73.05	74.4	0	0	0
Richmond	0	0	1.3 (2)	0 (0)	73.05	74.4	0	0	0
Total	0	0	4.7 (7)	5.2 (1)	365.25	375.1	0	0	0

RISK-WEIGHTED SURVEILLANCE FOR CHRONIC WASTING DISEASE IN NEW YORK

	Demographic Risk		Hazard Risk					CWD Unit Points	Point Sampling Quota
	Deer harvest	Demographic Risk Points	Processor/Taxidermist Risk Score (number of businesses)	Cervid Facility Risk Score (number of facilities)	Neighboring State Conditions Risk Score	Total Hazard Risk Score	Hazard Risk Points		
Region 3									
Dutchess	2,942	17	29.1 (10)	24.8 (8)	0	53.9	35	0	52
Orange	5,784	34	43.7 (18)	4.0 (2)	154.05	201.8	130	0	164
Putnam	501	3	10.3 (4)	1.0 (1)	0	11.3	7	0	10
Rockland	428	3	4.7 (2)	0 (1)	73.05	77.7	50	0	53
Sullivan	5,387	32	50.4 (14)	17.3 (6)	154.05	221.7	143	0	175
Ulster	4,480	26	43.5 (22)	3.0 (4)	0	46.5	30	0	56
Westchester	1,282	8	6.9 (3)	4.9 (2)	73.05	84.9	55	0	63
Total	20,804	123	188.6 (73)	54.9 (24)	454.2	697.7	450	0	573

	Demographic Risk		Hazard Risk					CWD Unit Points	Point Sampling Quota
	Deer harvest	Demographic Risk Points	Processor/Taxidermist Risk Score (number of businesses)	Cervid Facility Risk Score (number of facilities)	Neighboring State Conditions Risk Score	Total Hazard Risk Score	Hazard Risk Points		
Region 4									
Albany	2,912	17	9.5 (8)	2.0 (3)	0	11.5	7	0	24
Columbia	3,841	23	22.8 (12)	13.8 (3)	0	36.6	24	0	47
Delaware	6,111	36	24.4 (14)	25.7 (7)	154.05	204.1	131	0	167
Greene	2,533	15	19.6 (8)	5.0 (5)	0	24.6	16	0	31
Montgomery	1,863	11	8.1 (3)	8.2 (6)	0	16.3	10	0	21
Otsego	6,424	38	17.0 (15)	11.0 (9)	0	28.0	18	0	56
Rensselaer	3,816	22	25.0 (13)	5.0 (4)	91.05	121.0	78	0	100
Schenectady	867	5	9.6 (8)	0 (0)	0	9.6	6	0	11
Schoharie	3,477	20	12.8 (9)	5.0 (3)	0	17.8	11	0	31
Total	31,844	187	148.8 (90)	75.7 (40)	245.1	469.6	301	0	488

RISK-WEIGHTED SURVEILLANCE FOR CHRONIC WASTING DISEASE IN NEW YORK

	Demographic Risk		Hazard Risk					CWD Unit Points	Point Sampling Quota
	Deer harvest	Demographic Risk Points	Processor/Taxidermist Risk Score (number of businesses)	Cervid Facility Risk Score (number of facilities)	Neighboring State Conditions Risk Score	Total Hazard Risk Score	Hazard Risk Points		
Region 5									
Clinton	1,353	8	14.3 (18)	20.6 (9)	55.05	90.0	58	0	66
Essex	1,475	9	6.0 (9)	6.2 (2)	55.05	67.3	43	0	52
Franklin	2,152	13	4.0 (6)	3.0 (3)	0	7.0	5	0	18
Fulton	1,201	7	8.7 (13)	6.0 (4)	0	14.7	9	0	16
Hamilton	868	5	0.7 (1)	0 (1)	0	0.7	0	0	5
Saratoga	2,735	16	8.0 (12)	0 (0)	0	8.0	5	0	21
Warren	1,070	6	1.3 (2)	4.0 (4)	0	5.3	3	0	9
Washington	3,526	21	9.4 (9)	14.6 (6)	55.05	79.0	51	0	72
Total	14,380	85	52.5 (70)	54.4 (29)	165.15	272.1	174	0	259

	Demographic Risk		Hazard Risk					CWD Unit Points	Point Sampling Quota
	Deer harvest	Demographic Risk Points	Processor/Taxidermist Risk Score (number of businesses)	Cervid Facility Risk Score (number of facilities)	Neighboring State Conditions Risk Score	Total Hazard Risk Score	Hazard Risk Points		
Region 6									
Herkimer	3,134	18	20.4 (5)	3.0 (3)	0	23.4	15	0	33
Jefferson	8,559	50	17.1 (10)	21.6 (7)	0	38.7	25	0	75
Lewis	4,021	24	18.0 (5)	30.2 (9)	0	48.2	31	0	55
Oneida	5,478	32	34.3 (13)	16.3 (9)	0	50.5	32	0	64
St. Lawrence	6,014	35	68.0 (25)	6.0 (8)	0	74.0	48	0	83
Total	27,206	159	157.8 (58)	77.1 (36)	0	234.8	151	0	310

RISK-WEIGHTED SURVEILLANCE FOR CHRONIC WASTING DISEASE IN NEW YORK

	Demographic Risk		Hazard Risk					CWD Unit Points	Point Sampling Quota
	Deer harvest	Demographic Risk Points	Processor/Taxidermist Risk Score (number of businesses)	Cervid Facility Risk Score (number of facilities)	Neighboring State Conditions Risk Score	Total Hazard Risk Score	Hazard Risk Points		
Region 7									
Broome	4,752	28	28.8 (20)	3.0 (3)	154.05	185.9	120	0	148
Cayuga	5,340	31	41.2 (19)	7.0 (5)	0	48.2	31	0	62
Chenango	5,325	31	9.6 (8)	13.4 (6)	0	23.0	15	0	46
Cortland	3,138	18	25.3 (11)	9.2 (3)	0	34.5	22	0	40
Madison	4,818	28	26.1 (9)	7.0 (5)	0	33.1	21	0	49
Onondaga	4,533	27	34.6 (23)	9.7 (4)	0	44.3	28	0	55
Oswego	5,595	33	47.5 (25)	34.4 (12)	0	81.9	53	0	86
Tioga	4,021	24	13.9 (10)	10.2 (6)	154.05	178.1	115	0	139
Tompkins	4,134	24	16.3 (9)	2.0 (2)	0	18.3	12	0	36
Total	41,656	244	243.4 (134)	95.4 (46)	308.1	647.4	417	0	661

	Demographic Risk		Hazard Risk					CWD Unit Points	Point Sampling Quota
	Deer harvest	Demographic Risk Points	Processor/Taxidermist Risk Score (number of businesses)	Cervid Facility Risk Score (number of facilities)	Neighboring State Conditions Risk Score	Total Hazard Risk Score	Hazard Risk Points		
Region 8									
Chemung	3,255	19	20.5 (10)	2.0 (3)	154.05	176.6	114	0	133
Genesee	5,802	34	19.5 (15)	4.0 (2)	0	23.5	15	0	49
Livingston	8,224	48	21.8 (21)	6.0 (2)	0	27.8	18	0	66
Monroe	5,194	30	43.4 (27)	32.3 (12)	0	75.7	49	0	79
Ontario	6,914	41	10.1 (16)	18.4 (8)	0	28.5	18	0	59
Orleans	4,707	28	28.7 (9)	4.0 (2)	0	32.7	21	0	49
Schuyler	3,499	21	5.9 (6)	5.0 (5)	0	10.9	7	0	28
Seneca	2,133	13	11.3 (5)	0 (0)	0	11.3	7	0	20
Steuben	15,452	91	64.5 (24)	12.2 (4)	154.05	230.8	148	0	239
Wayne	5,992	35	46.0 (24)	24.7 (7)	0	70.7	45	0	80
Yates	4,598	27	11.1 (13)	9.0 (8)	0	20.1	13	0	40
Total	65,770	387	282.8 (170)	117.6 (53)	308.1	708.5	455	0	842

Region 9	Demographic Risk		Hazard Risk					CWD Unit Points	Point Sampling Quota
	Deer harvest	Demographic Risk Points	Processor/Taxidermist Risk Score (number of businesses)	Cervid Facility Risk Score (number of facilities)	Neighboring State Conditions Risk Score	Total Hazard Risk Score	Hazard Risk Points		
Allegany	10,385	61	36.0 (12)	15.4 (5)	154.05	205.5	132	0	193
Cattaraugus	9,755	57	23.1 (15)	15.6 (6)	154.05	192.7	124	200	200
Chautauqua	10,894	64	30.4 (8)	27.9 (13)	154.05	212.4	137	300	300
Erie	6,990	41	32.2 (18)	26.0 (14)	0	58.2	37	0	78
Niagara	3,294	19	24.3 (15)	8.0 (5)	0	32.3	21	0	40
Wyoming	6,491	38	26.2 (16)	22.1 (6)	0	48.3	31	0	69
Total	47,809	280	172.1 (84)	115.1 (49)	462.15	749.3	482	500	880



Acknowledgments

Funding for this project was cooperatively provided by the Wildlife Restoration Program, which derives monies through an excise tax on sporting arms and ammunition paid by hunters and recreational shooters. We thank Jennifer Peaslee for administrative support. We would like to acknowledge all NYSDEC administrators, biologists, technicians, and wildlife officers who helped collect the data necessary for the risk assessment.

References

- Ableman, A., K. Hynes, K. Schuler, and A. Martin. 2019. Partnering with taxidermists for improved chronic wasting disease surveillance. *Animals* 9, 1113; doi:10.3390/ani9121113.
- Almberg, E. S., P. C. Cross, C. J. Johnson, D. M. Heisey, and B. J. Richards. 2011. Modeling routes of chronic wasting disease transmission: Environmental prion persistence promotes deer population decline and extinction. *PLoS ONE* 6:e19896.
- Belsare, A. V., M. E., Gompper, B. Keller, J. Sumners, L. Hansen, and J. J. Millspaugh. 2020. An agent-based framework for improving wildlife disease surveillance: a case study of chronic wasting disease in Missouri white-tailed deer. *Ecological Modelling* 417:108919.
- Benestad, S. L., G. Mitchell, M. Simmons, B. Ytrehus, and T. Vikøren. 2016. First case of chronic wasting disease in Europe in a Norwegian free-ranging reindeer. *Veterinary Research* 47:88. *BioMed Central*.
- Bishop, R. C. 2004. The economic impacts of chronic wasting disease (CWD) in Wisconsin. *Human Dimensions of Wildlife* 9:181–192.
- Decker, D. J., K. Schuler, A. B. Forstchen, M. A. Wild, and W. F. Siemer. 2016. Wildlife Health and Public Trust Responsibilities for Wildlife Resources. *Journal of Wildlife Diseases* 52:775–784.
- DeVivo, M. T., D. R. Edmunds, M. J. Kauffman, B. A. Schumaker, J. Binfet, T. J. Kreeger, B. J. Richards, H. M. Schätzl, and T. E. Cornish. 2017. Endemic chronic wasting disease causes mule deer population decline in Wyoming. *PLoS ONE* 12:1–17.
- Edmunds, D. R., M. J. Kauffman, B. A. Schumaker, F. G. Lindzey, W. E. Cook, T. J. Kreeger, R. G. Grogan, and T. E. Cornish. 2016. Chronic Wasting Disease Drives Population Decline of White-Tailed Deer. *Plos One* 11:e0161127.
- Fitzgerald, R. 2017. They smuggled deer to Forrest County, feds say. But that wasn't the only problem. <https://www.sunherald.com/news/local/crime/article173323226.html>. Accessed 10 August 2018.
- Georgsson, G., Sigurdarson, S., and Brown, P. 2006. Infectious agent of sheep scrapie may persist in the environment for at least 16 years. *Journal of General Virology* 87:3737-3740.
- Heisey, D. M., C. S. Jennelle, R. E. Russell, and D. P. Walsh. 2014. Using auxiliary information to improve wildlife disease surveillance when infected animals are not detected: a Bayesian approach. *PLoS ONE* 9:e89843.
- Jennelle, C. S., D. P. Walsh, M. D. Samuel, E. E. Osnas, R. Rolley, J. Langenberg, J. G. Powers, R. J. Monello, E. D. Demarest, R. Gubler, and D. M. Heisey. 2018. Applying a Bayesian Weighted Surveillance Approach to Detect Chronic Wasting Disease in White-tailed Deer. *Journal of Applied Ecology* 1–40.
- Johnson, C. J., K. E. Phillips, P. T. Schramm, D. McKenzie, J. M. Aiken, and J. A. Pedersen. 2006. Prions adhere to soil minerals and remain infectious. *PLoS Pathogens* 2:296–302.
- Monello, R. J., J. G. Powers, N. T. Hobbs, T. R. Spraker, M. K. Watry, and M. A. Wild. 2014. Survival and population growth of a free-ranging elk population with a long history of exposure to chronic wasting disease. *The Journal of Wildlife Management* 78:214–223.
- Needham, M. D., and J. J. Vaske. 2008. Hunter Perceptions of Similarity and Trust in Wildlife Agencies

- and Personal Risk Associated with Chronic Wasting Disease. *Society & Natural Resources* 21:197–214.
- Needham, M. D., J. J. Vaske, and M. J. Manfredo. 2006. State and Residency Differences in Hunters' Responses to Chronic Wasting Disease. *Human Dimensions of Wildlife* 11:159–176.
- New York State Department of Environmental Conservation, New York State Department of Agriculture and Markets, and Cornell University College of Veterinary Medicine. 2018. New York State Interagency Chronic Wasting Disease Minimization Plan. https://www.dec.ny.gov/docs/wildlife_pdf/cwdpreventionplan2018.pdf. Accessed November 2021.
- Plummer, I. H., S. D. Wright, C. J. Johnson, J. A. Pedersen, and M. D. Samuel. 2017. Temporal patterns of chronic wasting disease prion excretion in three cervid species. *Journal of General Virology* 1–11.
- Pritzkow, S., R. Morales, F. Moda, U. Khan, G. C. Telling, E. Hoover, and C. Soto. 2015. Grass Plants Bind, Retain, Uptake, and Transport Infectious Prions. *Cell Reports* 1–8.
- Tidd, J. 2018. Trophy-hunting business owner admits to illegally importing deer to Kansas. <https://www.kansas.com/sports/outdoors/article198543619.html>. Accessed 10 August 2018.
- Walsh, D. 2012. Enhanced surveillance strategies for detecting and monitoring chronic wasting disease in free-ranging cervids: U.S. Geological Survey Open-File Report 2012–1036. 42 p.
- Wood, M., P. Griebel, M. Huizenga, S. Lockwood, C. Hansen, A. Potter, N. Cashman, J. Mapletoft, and S. Napper. Accelerated onset of chronic wasting disease in elk (*Cervus canadensis*) vaccinated with a PrP^{Sc}-specific vaccine and housed in a prion-contaminated environment. *Vaccine* 29;36(50):7737-7743.

Glossary

Captive cervid facility – general term for a location that holds cervids within a game-proof perimeter fence or confined area, such as a barn or pen, regardless of whether said cervid(s) may be claimed under private ownership and the purpose for which the cervids are being held.

Cervid – hooved mammal of the family Cervidae that typically grows and sheds antlers yearly, includes deer, elk, and moose.

Environmental contamination – prions shed in carcasses, urine, feces, and saliva bind to the soil and plants and remain infectious to deer.

Hazard – a condition or physical situation with a potential for an undesirable consequence or to cause harm, e.g., may introduce or spread CWD prions.

Prevalence – number of animals positive for CWD divided by number of animals in the population.

Prion – misfolded protein that is the infectious agent of CWD.

Risk – possibility that something unpleasant will happen or situation involving exposure to danger.

Risk assessment - a systematic process of evaluating the potential risks that may be involved in a specified activity or practice.

Wildlife health - the vitality and integrity of wildlife species at population levels that support their functional roles in sustaining ecological systems that benefit society and the natural world.