

Understanding CWD Surveillance



Background:

Chronic Wasting Disease (CWD) is a transmitted prion disease of cervids (deer, elk, and moose). While the origins of CWD are uncertain, the disease has been present in wild cervid populations for nearly 50 years and has now been reported in farmed and free-ranging populations in 25 American states, two Canadian provinces, Finland, Norway and the Republic of Korea. Of the 25 American states that have found CWD, three states have found CWD in the farmed cervid populations but not the wild. Eight states have found CWD in the wild populations but not in the farmed populations.

Research Questions:

The Elk Research Foundation, which serves as a research foundation of the North American Elk Breeders Association, contracted a statistician that can assess CWD surveillance levels in several scenarios. The Elk Research Foundation (ERF), along with Exotic Wildlife Association, Texas Deer Association and the Wisconsin Cervid Farmers Foundation (WCFF) of the Whitetails of Wisconsin posed the following questions.

- 1) Determine the statistical confidence level of Chronic Wasting Disease sampling of free ranging deer herds in a state with no known cases of Chronic Wasting Disease.
- 2) Compare the probability of finding Chronic Wasting Disease in a county with a large farmed cervid population.
- 3) Determine the statistical confidence level of CWD sampling in Kentucky's wild elk herd.

Executive Summary:

This study reviewed CWD surveillance data in several states to answer four questions posed by the cervid industry. Data for this study was acquired through open record requests via the local state agriculture and/or natural resources agencies.

The study concludes in an answer to question #1 was that there are scenarios in states with no known positives cases of CWD that do test the free-ranging herd at a high level. As an example, Georgia, has recently acquired a statewide sampling rate of 95-2. Therefore, there is a 95% confidence level that CWD would be detectable in the state if disease prevalence was 2%.

The study concludes in an answer to question #2 was if CWD exists in a state or county but has not been detected, it is highly probable that the CWD disease will be discovered in the farmed cervid population first because of the greater number of samples collected and tested.

For example, Indiana is a state with a large farmed cervid population. LaGrange County is home to many farmed deer ranches. There are no known CWD positive cases in the state. Based on 2012 data, if CWD were to spread into LaGrange County and exist at an

equally low prevalence in both the farmed and wild cervid populations, it is 89% more likely it will be found on a deer ranch first.

The study concludes in an answer to question #3 the statistical confidence level of CWD sampling of Kentucky's wild elk herd that is relocated to other states is 95-3. 299 samples must be collected to obtain a 95-1 surveillance rate. Only 84 were tested.

Project Summary:

To answer the three research questions posed by the cervid industry, this study reviewed CWD surveillance data in several states. The questions themselves aim to be very targeted for specific circumstances, therefore the study attempted to find jurisdictions that mimicked the specific scenarios of the questions as much as possible. Data for this study was acquired through open record requests via the local agriculture and/or natural resources agency.

In response to Research Question #1- "Determine the statistical confidence level of CWD sampling of free ranging deer herds in a state with no known cases of CWD."

This question is essentially asking what is the overall state sampling confidence level of the wild cervid herds. The study question #1 best fits the State of selected Georgia. Georgia is a since this state that prohibits interstate movement of cervids with no known CWD positives in the state. Most recent available data (2014) indicates that the statewide sampling rate is 95-2. There is a 95% confidence level that CWD would be detectable in the state if disease prevalence was 2%.

Research Question #2 was to compare the probability of finding CWD in a county with a large farmed cervid population.

Therefore, if CWD is present in a county, given the sampling data, what is the probability it will be found in the farmed herds first?

To best answer question #2, the study selected Indiana as a state with a large farmed cervid population with one county in particular (LaGrange County) as home to many farmed deer ranches. There is no known CWD positive cases in the entire state. If CWD were to spread into LaGrange County and exist at an equally low prevalence in both the farmed and wild cervid populations, it would be highly probable that CWD would be discovered in the farmed population first.

For example, if the prevailing CWD prevalence were 1% in the area then the chance of discovering the disease in the farmed population first is roughly 89%. The probability of discovering disease only in the wild first is 2.5% and the probability of discovering disease in both populations in the same sampling period is 8%. The general message here is that given the reality of CWD sampling in the wild and farmed populations for this specific county, it is highly probable that disease will be discovered in the farmed population first.

Research question #3 asked to determine the statistical confidence level of CWD sampling of Kentucky's wild elk herd that is often relocated to other states for elk restoration projects. 84 wild elk samples were collected for CWD sampling in 2013. Based on the wild elk herd population that resides in 16 counties, the sampling rate for the wild elk herd is 95-3. However, since Chronic Wasting Disease is in fact transmittable between whitetail deer and elk where the wild elk herd resides, then this rate for elk is potentially misleading. 299 samples must be collected to obtain a 95-1 surveillance rate.

RESEARCH QUESTION #1:

What is overall state sampling confidence level of the wild herds in Georgia?

BACKGROUND AND ANALYSIS SUMMARY: Georgia is a state that prohibits interstate movement of cervids. There is no known CWD positives in the state. Most recent available data (2014) indicates that the statewide sampling rate is approximately 95-2. There is a 95% confidence level that CWD would be detectable in the state if disease prevalence was 2%.

Communication received from Georgia Department of Natural Resources:

Wild deer herd population by region:

- Ridge and Valley = 97,773
- Blue Ridge Mountains = 14,878
- Piedmont = 571,207
- Upper Coastal Plain = 361,665
- Lower Coastal Plain = 323,880

We do not have any target number of animals to sample either by region or state. Our sampling effort is conducted and managed as a statewide effort, thus the number of samples is not organized by region. As such there is no statistical method used to determine a target number of animals to sample. The statewide totals per year for wild deer are as follows:

- 2011=590
- 2012=94
- 2013=188
- 2014=145
- 2015=Samples have not been centralized and totaled yet
- 2016= Samples have not been centralized and totaled yet

ANALYSIS:

Based on the data provided by the Georgia Department of Natural Resources:

Table 1. Historical confidence levels assuming different disease prevalence

year	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08
2011	0.997	1.000	1.000	1.000	1.000	1.000	1.000	1
2012	0.611	0.850	0.943	0.978	0.992	0.997	0.999	1
2013	0.849	0.978	0.997	1.000	1.000	1.000	1.000	1
2014	0.767	0.947	0.988	0.997	0.999	1.000	1.000	1

Table 2. Historical disease prevalence detectable at different confidence levels

year	0.95	0.97	0.99
2011	0.005	0.006	0.008
2012	0.031	0.037	0.048
2013	0.016	0.018	0.024
2014	0.020	0.024	0.031

Contained in tables 1 and 2 are different ways of looking at the provided annual sampling data. Table 1 is calculating the confidence level or probability of discovering at least one diseased animal. Each column represents a different level of disease prevalence. If you assume a 1% disease prevalence (first column), then the confidence level in 2011 of .997 drops to .611 in 2012.

Table 2 contains calculated disease prevalence detectable at different confidence levels. In 2011, a 0.5% disease prevalence was detectable at a .95 confidence level. In 2012 the detectable disease prevalence with .95 confidence rose to 3.1%.

RESEARCH QUESTION #2:

Given the most recently available sampling data, if CWD were present in LaGrange county Indiana what is the probability it will be found in the farmed herds first?

BACKGROUND AND ANALYSIS SUMMARY:

Indiana is a state with a large farmed cervid population estimated to be 730,000 in 2012. LaGrange County is home to many farmed deer ranches and in 2012 the total farmed deer population in that county was estimated to be 2,013. There are no known CWD positive cases in the state. According to INDR CWD's 2012 sample report, 9 total samples were collected from the wild population in LaGrange County while 145 samples were taken from the farmed population in the same county.

If CWD were to spread into LaGrange County and exist at an equally low prevalence in both the farmed and wild cervid populations, it would be highly probable that CWD would be discovered in the farmed population first. For example, at the provided sampling rates and using a CWD prevalence of 1% in the county then the chance of discovering the disease in the farmed population first is roughly 89/100.

ANALYSIS:

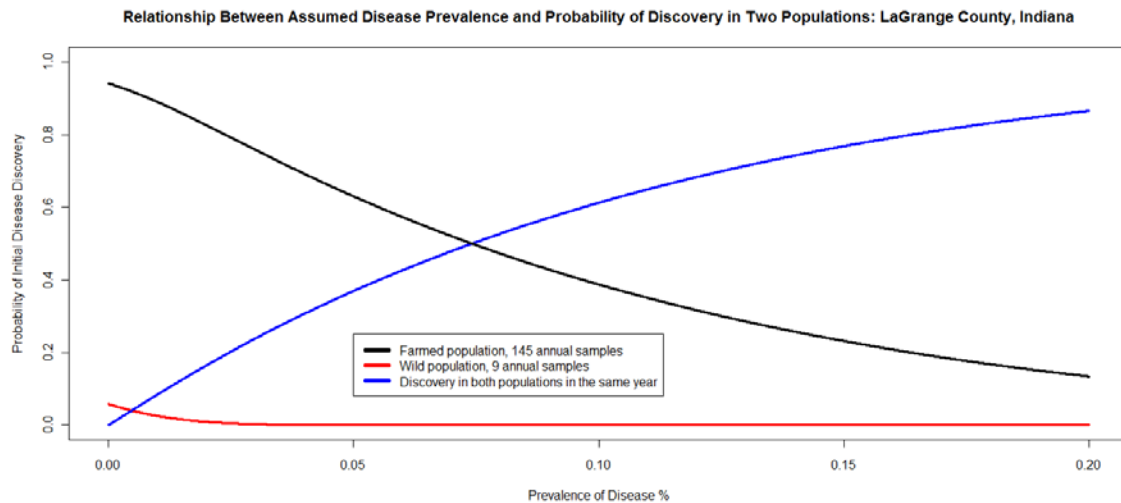


Figure 1. Relationship between assumed disease prevalence and probability of discovery

There are three possible outcomes to consider when sampling for CWD in both the wild and farmed populations:

1. CWD is discovered in at least one sample from the farmed population and none in the wild population during the sampling period.
2. CWD is discovered in at least one sample from the wild population and none are discovered in the farmed population during the sampling period.

3. CWD is discovered in at least one sample from both the wild and farmed populations during the same sampling period

For this example, it is assumed that sampling period is one year. It is also assumed that disease prevalence is the same for both populations. Sampling rates from 2012 were used in all calculations.

Table 3. Calculated probabilities of initial discovery of CWD in each population and at different assumed prevalence

prevalence	farmed	wild	both
0.01	0.8901	0.0256	0.0843
0.02	0.8260	0.0093	0.1647
0.03	0.7580	0.0029	0.2391
0.04	0.6920	0.0008	0.3072
0.05	0.6301	0.0002	0.3697
0.06	0.5730	0.0001	0.4270
0.07	0.5204	0.0000	0.4796
0.08	0.4722	0.0000	0.5278
0.09	0.4279	0.0000	0.5721
0.10	0.3874	0.0000	0.6126

The first row of Table 3 shows the calculated probabilities for an assumed CWD population prevalence of 1%. At this assumed rate of disease and sampling, the probability of discovering the disease only in the farmed population first is .89. The probability of discovering disease only in the wild first is .025, and the probability of discovering disease in both populations in the same sampling period is .0843.

RESEARCH QUESTION #3:

Determine the statistical confidence level of CWD sampling in Kentucky’s wild elk herd.

BACKGROUND AND ANALYSIS SUMMARY:

Based on the number of samples being taken from the wild whitetail population there is a statewide 95-0.3 confidence sampling level. When considered independent from the whitetail population, the statewide sampling rate for elk is 95-3. Since CWD is transmittable between whitetail deer and elk and the two populations exist in the same regions, conducting a separate analysis for each group is potentially misleading.

Information provided by Kentucky:

Table 4. Total 2013 elk samples taken in counties where the wild elk herd is known to reside:

<u>County</u>	
Bell	7
Breathitt	5
Clay	3
Floyd	11
Harlan	3
Johnson	3
Knott	25
Knox	0
Leslie	1
Letcher	4
Magoffin	1
Martin	11
McCreary	3
Perry	5
Pike	2
Whitley	0
	TOTAL
	84

KYFWR estimates 10,000-11,000 wild elk population in these counties. (KYFWR narrative)

KYFWR estimates 600 elk are harvested a year in these counties. (2013 report)

KYFWR reports 58 CWD samples were collected for elk in 2013 (appendix 5)

KYFWR reports 1,094 Total samples of deer and elk were collected statewide (Appendix 7)

KYFWR reports 1,036 Total samples of deer were collected statewide (Appendix 7)

FYFWR estimates there are 752,000 whitetail deer in the wild (www.ky.gov)

Analysis:

1) Based on 84 annual samples, what is the confidence prevalence level for elk in 2013?

Table 5. Historical confidence levels assuming different disease prevalence

	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08
2013	0.57	0.817	0.923	0.968	0.987	0.994	0.998	0.999

Table 6. Historical disease prevalence detectable at different confidence levels

	0.95	0.97	0.99
2013	0.035	0.041	0.053

2) How many samples are needed to be 95-2?

Minimum of 149 samples

3) How many samples are needed to be 95-1?

Minimum of 299 samples

4) What is the number of samples tested to obtain a 99-5?

Minimum of 59 samples

5) What is the number of samples tested to obtain a 99-1?

Minimum of 459 samples

6) Based on 1036 samples, what is the statewide confidence prevalence level for whitetail deer statewide?

Table 7. Historical confidence levels assuming different disease prevalence.

	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08
Whitetail	0.99997	1	1	1	1	1	1	1

Table 8. Historical disease prevalence detectable with different confidence levels.

	0.95	0.97	0.99
Whitetail	0.003	0.003	0.004