

***CHRONIC WASTING DISEASE
AND THE HOLDING OF DEER IN CAPTIVITY***

***North Carolina Wildlife Resources Commission
Division of Wildlife Management***



December 2011

Talking Points Chronic Wasting Disease (CWD)

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CWD- Disease and Epidemiology

- CWD has not been detected in any samples from cervids tested from within North Carolina.
- CWD is always fatal to infected cervids.
- CWD is neither a bacteria nor a virus but is an infectious protein (i.e., prion) that has the ability to change healthy proteins. It is similar to mad cow disease in cattle, scrapie in sheep and Creutzfeldt-Jakob Disease (CJD) in humans. Note that variant-CJD (vCJD) is the human disease contracted from eating cattle infected with mad cow disease.
- CWD was first discovered in a single captive mule deer in Colorado in 1967 and originally thought to be a wasting disease specific to mule deer. Since then, six other cervid species or subspecies have become naturally infected (i.e., infected through normal biological processes, not experimentally): Black-tailed deer (1979), Elk (1979), White-tailed deer (2001), Moose (2005), Sika deer (2010), Red deer hybrids (2010).
- As of October 28, 2011 CWD had been detected in 19 states (Colorado, Illinois, Kansas, Maryland, Michigan, Minnesota, Missouri, Montana, Nebraska, New Mexico, New York, North Dakota, Oklahoma, South Dakota, Utah, Virginia, West Virginia, Wisconsin and Wyoming), 2 Canadian provinces (Alberta and Saskatchewan), and Korea.
- A CWD-infected animal may not show outward signs of the disease. The incubation period ranges from approximately 17 months to greater than 15 years. However, most clinical signs show up within 3-5 years of being infected.
- The disease may be transmitted by direct contact or environmentally through saliva, urine, feces, tissue, soil, water, feed, etc. Infectious prions can exist in the environment for years in conditions or in spite of treatments that kill or inactivate conventional infectious agents such as viruses or bacteria. As a result, some captive cervid pens where CWD was prevalent have been declared “Highly Contaminated Areas” and quarantined permanently.
- Other species have been experimentally infected with CWD using intracerebral and/or oral inoculations in laboratory conditions including: fallow deer, muntjac deer, cattle, sheep, ferrets, raccoons and squirrel monkeys.
- The spatial distribution of where CWD has been detected is inconsistent with natural movement of free-ranging animals. This distribution shows concentrations in hotspots of varying sizes that are separated by wide distances. The implication of this distribution is

that it is associated with the human-assisted movement of infected animals or of materials containing infectious prions.

- In 2010, 49% of mule deer sampled from a wild Wyoming herd tested positive for CWD. This same herd has decreased in size by more than 50% over the preceding 10 years. Research is currently underway to determine CWD's role in this decline.
- Hemorrhagic Disease (HD) – is a common name of two viruses that are closely related to each other and that affect deer in North Carolina (i.e., EHD and Bluetongue). Outbreaks of this disease may be mild to severe and occur periodically. Typically less than 25% of the population dies and survivors are thereafter immune to the particular strain that they contracted. The media and public sometimes confuse HD with CWD.
- CWD and tuberculosis are the diseases of highest concern associated with the human-assisted movement of deer (especially illegal movement). CWD is a concern because of its impact directly on wild deer environmental contamination. Tuberculosis is a concern because of direct impacts to the wild deer herd and potentially devastating impacts on North Carolina's agribusinesses, especially livestock.
- CWD is a non-treatable disease. The best defense against getting the disease in North Carolina is to strictly regulate movement of animals and potentially infectious materials into and within the state and to pursue greater penalties for the illegal possession or transport of cervids.
- The NCWRC conducts systematic statewide CWD surveillance on free-ranging whitetail deer every 5 years. During the 2003 sample period 1,488 samples were collected; during the 2008 sample period 1,403 samples were collected. Most of these samples come from hunter or automobile-killed deer. Samples are taken anytime from whitetail deer exhibiting clinical signs of a central nervous system disorder whenever they occur regardless of the 5 year surveillance schedule. Also, all cervids that die in a pen are required to be tested for CWD. To date, CWD has not been detected in any sample from North Carolina.

Human Health Risks

- The foodborne transmission of mad cow disease to humans indicates that the species barrier may not completely protect humans from animal prion diseases, potentially including CWD. Conversion of human prion protein by CWD-associated prions has been demonstrated in lab experiments. However, there is currently no evidence that CWD is transmissible to humans.
- There is some evidence that different CWD strains exist but much is still unknown about the specific biology of CWD prions. Results from a recent laboratory study indicate that CWD has the potential to transfer to humans. Again, this is based on laboratory experiments; there are no known cases of CWD transferring to humans.
- The Centers for Disease Control (CDC) recommends that hunters and others should avoid eating meat from deer and elk that look sick or that test positive for CWD.

- A normal appearing animal can harbor and spread the disease for multiple years.
- When captive deer mature, especially males, they can become aggressive and endanger people. Documented human injury has occurred by deer that were raised in captivity and subsequently lose their fear of humans.

Economic Impacts- State Government

- Wisconsin spent approximately \$25 million on CWD-related activities from 2002-2006. These direct expenditures do not include other broader economic impacts. Hunting license sales declined 10% in the first year after CWD was detected in Wisconsin.
- Virginia's wildlife agency has incurred annual direct costs of \$180,000 since CWD was discovered. These direct costs do not include staff and vehicle costs, other personnel-related expenditures, or broader economic impacts.
- North Carolina has been very proactive in efforts to protect wild and captive cervids from CWD. Early efforts consisted of implementation of temporary rules relative to movement and possession of cervids followed by a more deliberative approach to crafting rules and statutes to insure continued protection of public and private wildlife resources. In addition, legal captive cervid facilities were offered a buyout option using up to \$250,000 of the Wildlife Endowment Fund. This buyout opportunity allowed facility owners the ability to get out of the captive cervid business at a time when marketability was dropping rapidly due to CWD concerns and allowed the agency to test large numbers of potentially high-risk animals for CWD (e.g., there were cervids in pens in North Carolina that originated from Wisconsin captive pens).
- Assuming a 10% reduction in deer hunters in North Carolina following detection of CWD (as was the case in Wisconsin), we estimate that NCWRC would lose approximately \$976,820 annually in license sales if CWD was detected in North Carolina with additional impacts to federal assistance (i.e., Pittman-Robertson Federal Aid in Wildlife Restoration) funds as the number of certified license holders declines.

Economic Impacts- Private Business and General Public

- Hunting is big business in North Carolina. During 2006 (the most recent year from which data are available), 277,357 resident hunters spent \$488 million on retail purchases which generated \$818 million in economic output. These expenditures supported 8,332 jobs and contributed to \$46 million in state tax revenue.
- During 2006 (the most recent year from which data are available), 197,220 North Carolina resident deer hunters spent \$187 million on retail purchases thereby generating \$322 million in economic output. These expenditures supported 3,408 jobs and contributed to \$20 million in state tax revenue. Deer hunters also spent \$50 million for travel-related expenses.
- Assuming a 10% reduction in deer hunters in North Carolina following detection of CWD (as was the case in Wisconsin) and using the 2006 economic data, we estimate that

detection of CWD in North Carolina would have multiple, negative economic impacts including: an \$18.7 million dollar impact on retail sales to deer hunters, a \$32 million impact on economic output, a \$5 million impact to travel-related expenditures, a \$2 million impact to state tax revenue, and the loss of 340 jobs.

- Recreational benefits are typically defined as the value of a recreational activity to individuals. It was estimated that Wisconsin hunters could lose \$70-\$100 million in recreational benefits in a single year. In essence, this value is putting a price tag measured in dollars on how much Wisconsin hunters value deer hunting. Using the same approach, North Carolina hunters could lose an estimated \$35-\$54 million in recreational benefits annually.

Captive Cervid Facilities

- As of October 2011, North Carolina has 44 licensed captive cervid facilities.

Legal Status and Public Perception

- White-tailed deer and elk in North Carolina are public resources. Based on the public trust doctrine these resources are owned by no one and belong to all citizens to be held in trust by the government for the benefit of present and future generations.
- N.C.G.S. § 113-131 mandates that the public trust doctrine be applied in North Carolina, specifically that “[t]he marine and estuarine and wildlife resources of the State belong to the people of the State as a whole.”
- Further, N.C.G.S. § 143-239 outlines the specific stewardship responsibilities of the NCWRC relative to these public trust resources as, “to manage, restore, develop, cultivate, conserve, protect, and regulate the wildlife resources of the State of North Carolina...”
- Finally, possession and ownership of wildlife are addressed in N.C.G.S. § 113-291; outlining specifically that no person could “take, possess, buy, sell, or transport any wildlife – whether dead or alive, in whole or in part. Nor may any person take, possess, buy, sell, or transport any nests or eggs of wild birds except as so permitted. No person may take, possess, buy, sell, or transport any wildlife resources in violation of the rules of the Wildlife Resources Commission”.
- Surveys show that hunting for meat or population control is largely supported by the general public. However, hunting for the specific purpose of obtaining a trophy is not supported. Thus, shooting “trophy animals” in confinement (i.e., canned hunts) is likely to be opposed by the general public.

Current Information Related to Chronic Wasting Disease (CWD)

December 2011



Herein, we provide a general review of Chronic Wasting Disease (CWD), including its known history and current status. A thorough review of CWD and the topics and categories discussed can be found at the CWD Alliance web page, (www.cwd-info.org) and the United States Geological Service's (USGS) Wildpro-Chronic Wasting Disease module (<http://wildpro.twycrosszoo.org>). Each site also provides a broader contextual framework and expanded discussions and scientific literature reviews beyond which can be reasonably included herein.

Disease Type

CWD is a Transmissible Spongiform Encephalopathy (TSE) that affects cervids (i.e., animals in the deer family, *Cervidae*). Other well-known diseases in this family include bovine spongiform encephalopathy (i.e., BSE or Mad Cow Disease), scrapie of domestic sheep and goats, and transmissible mink encephalopathy of farmed mink. Several variants of these types of disease are known to occur in humans worldwide, such as Creutzfeldt-Jakob disease (CJD) and variant Creutzfeldt-Jakob disease (vCJD) which is associated with the BSE agent where it occurs in cattle. vCJD was first described in Europe in 1996 when a relationship between mad cow disease and humans was discovered in Great Britain and other European countries.

Causative Agent

There is scientific consensus that the causative agent of TSEs, such as CWD, is a prion. A prion is a misfolded protein. Unlike other disease agents, such as bacteria or viruses, prions contain no DNA. Once in the body, diseased prions, such as the ones that cause CWD, increase in number by causing other proteins to convert to the diseased form. Diseased prions do not degrade but continue to accumulate within cells of lymphatic and neural tissues. The accumulation of diseased cells in the brain results in a sponge-like appearance of the brain tissue when viewed under a microscope. The end result is that infected animals develop neurological symptoms and appear to “waste away” as muscle tissue deteriorates. Once contracted, the disease is always fatal.

Affected Species

Originally discovered in a captive cervid facility in Colorado in 1967, CWD was thought to be an endemic disease of mule deer. Unfortunately, since that time it has spread to multiple species/subspecies of cervids.

Species/subspecies and year identified as naturally susceptible:

- Mule Deer 1967
- Black-tailed Deer (subspecies of mule deer) 1979
- Elk 1979
- White-tailed Deer 2001
- Moose 2005
- Sika Deer: 2010
- Red Deer hybrids: 2010

The ability for other cervid species or subspecies, or wildlife in other wild animal families to naturally contract CWD is not completely known, however ongoing research is exploring this question (CWD Alliance 2011). Considering the timeline above, it appears likely that more species or subspecies of cervids will naturally contract the disease.

Clinical Signs

Clinical signs of infection include:

- progressive and extreme weight loss,
- development of neurological symptoms,
- decreased social interaction as the disease progresses,
- loss of fear of humans and loss of overall awareness, and
- frequent urination and salivation associated with excessive drinking.

CWD Diagnostics

Research and development continues towards a live animal diagnostic test. While research is promising, no acceptable live animal test is currently available. The standard diagnostic test for CWD is the Immunohistochemistry (IHC) test performed on the obex tissue of the brain or specific lymphoid tissues. Other diagnostic tests such as utilizing enzyme-linked immunosorbent assay (ELISA) continue to be developed that allow more rapid testing of larger numbers of samples. Positive tests for CWD using the IHC test must be confirmed using the ELISA test.

CWD Transmission

CWD has a long incubation period, which is the time between initial infection and the appearance of signs or symptoms of the disease. The length of this incubation period is quite varied; though the minimum incubation period appears to be around 17 months with the maximum being greater than 15 years. Infected animals may remain asymptomatic while potentially spreading the disease to other deer. Because presence of the disease may not be detectable in asymptomatic animals, testing an animal does not yield a negative result, but rather it yields a non-detected result. It is unknown at what point infected deer are functionally contagious and, thus, capable of spreading the disease.

Research continues regarding CWD transmission. Obviously CWD is transmissible and infectious, but many of the details as to how it is transmitted are as yet unknown. There is evidence that the disease is primarily transmitted by contact with prions. Diseased prions have been detected in body fluids including blood, saliva, urine, and feces. Prions can also reside in the soil of areas where previously infected deer were contained and can subsequently infect “new” deer introduced to the site. This scenario is referred to as environmental contamination. The Colorado Division of Wildlife attempted to eliminate CWD from the Fort Collins Foothills Wildlife Research Facility by treating the soil with chlorine, removing the treated soil, and applying an additional chlorine treatment before letting the facility remain vacant for more than a year; the effort was unsuccessful (CWD Alliance 2011).

Diseased prions or TSE agents are extremely resistant in the environment and transmission is likely by both direct and indirect routes. A healthy animal could contract the disease either by coming into direct contact with an infected animal or coming into contact with contaminated soil and/or infected carcasses or animal products. Given the length of time that infectious prions appear to exist outside of the body and the difficulty in eradicating them with chemicals or other similar cleaning efforts, the introduction of a single infected deer or carcass part could eventually lead to significant disease prevalence rates within a specific area.

While the detection of CWD in some wild deer herds has been traceable to the source of the infection, others remain a mystery. Rarely can an exact source be documented for the first positive deer found in a wild deer population. Thus a specific cause and effect relationship between CWD in wild herds and CWD in captive herds is not always conclusive.

Because direct contact with prions appears to be necessary to transmit the disease, the most likely path of movement of the disease into new areas is through intentional or unintentional human movement of infected deer or deer carcass parts. Concentrating deer in captivity or at

artificial feeding sites increases the likelihood of direct and indirect transmission. Furthermore, the relative density of the wild deer herd also will impact the prevalence of the disease in wild populations.

Epidemiology

Minimum Known Incubation:	17 months
Maximum Incubation:	≥15 years
Youngest age of clinical diagnosis:	17 months
Point at which an infected animal becomes infectious:	Unknown

Chronology of CWD Detections (CWD Alliance 2011):

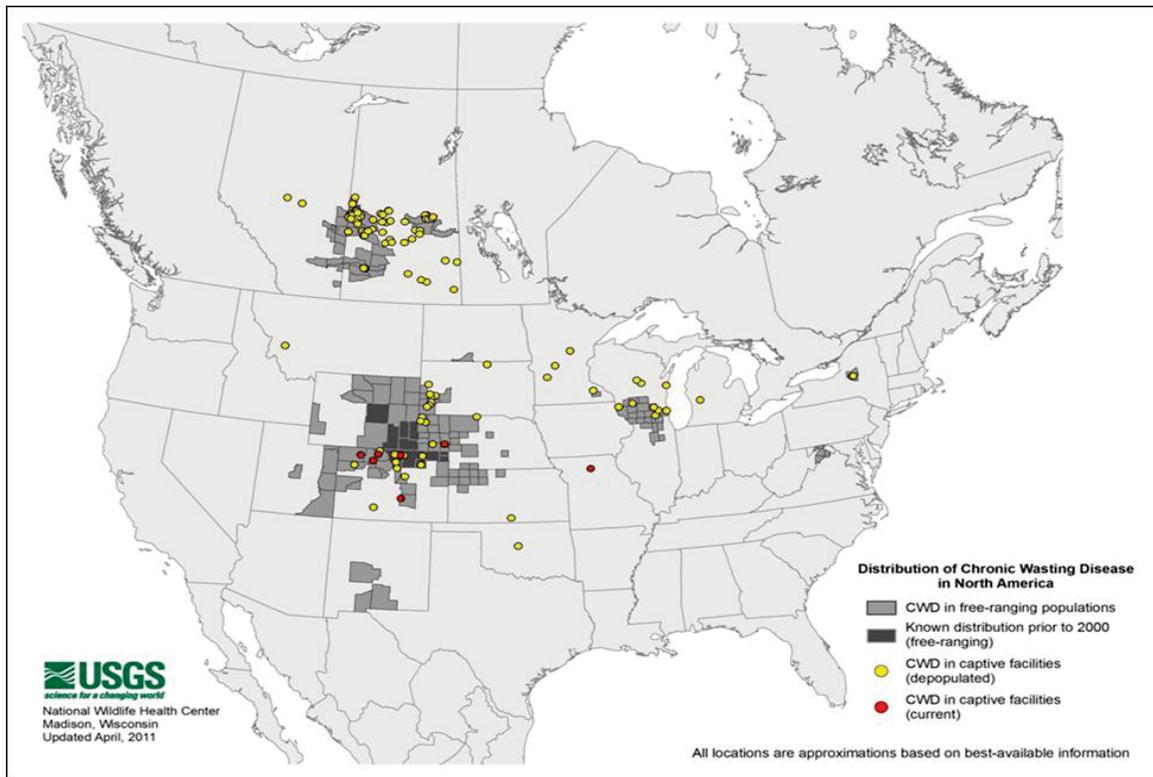
- 1967 – identified as a clinical disease of mule deer in Colorado
- 1978 – positively identified as a TSE
- 1979 – detected in mule deer in a Wyoming captive facility
- 1979 – detected for the first time in captive black-tail deer in a Wyoming facility (NEW SPECIES)
- 1979 – detected for the first time in captive elk (NEW SPECIES)
- 1981 – detected for the first time in wild cervids, elk in Colorado
- 1985 – detected in a wild mule deer in Colorado for the first time
 - detected in a wild mule deer in Wyoming for the first time
- 1996 – detected outside of Colorado/Wyoming in a captive elk farm in Saskatchewan
- 1997 – detected in several captive elk facilities in South Dakota
- 1999 – detected in wild mule deer in Nebraska
- 2000 – detected in wild mule deer in Saskatchewan
- 2001 – detected in wild white-tailed deer in South Dakota (NEW SPECIES)
- 2002 – detected in wild white-tailed deer in Wisconsin
 - detected in wild mule deer in New Mexico
 - detected in captive elk facility in Minnesota
 - detected for the first time in a captive white-tailed deer in Wisconsin
 - detected in wild mule deer outside of the previously delineated area in Saskatchewan
 - detected in captive elk facility in Oklahoma
 - detected in wild white-tailed deer in Illinois
 - detected in wild elk in South Dakota
 - detected in captive white-tailed deer in Alberta
 - detected for the first time west of the Continental Divide in Wyoming
- 2003 – detected in wild mule deer in Utah
- 2004 – detected in a location in Nebraska 250 miles from all previous locations
- 2005 – detected in a captive and a wild white-tailed deer in New York

- detected in wild white-tailed deer in West Virginia
- detected in a wild moose in Colorado (NEW SPECIES)
- detected for the first time in a wild mule deer in Alberta
- detected in wild elk in New Mexico
- 2006 – detected in white-tailed deer in Kansas
 - detected for the first time in captive white-tailed deer in Minnesota
- 2007 – detected in wild white-tailed deer for first time in Alberta
- 2008 – detected in wild elk populations in Saskatchewan
 - detected in captive white-tailed deer in Michigan
 - detected in moose for the first time in Wyoming
- 2010 – detected in wild white-tailed deer in Virginia
 - detected in captive white-tailed deer in Missouri
 - detected in wild mule deer in North Dakota
 - detected in sika deer and Red deer hybrid in Korea (NEW SPECIES)
- 2011 – detected in wild white-tailed deer in Minnesota
 - detected in wild white-tailed deer in Maryland

Translocation of the Disease

The above chronology illustrates the rapid spread of CWD across North America. The disease was first discovered in 1967 and was thought to be confined to mule deer and elk populations in Wyoming and Colorado for nearly 30 years. In 1996, the disease was discovered in a private captive elk facility in Saskatchewan containing elk that had been imported from private U. S. captive facilities. Known occurrence of the disease has spread from the original 2 states (Colorado and Wyoming) to 17 other states (Illinois, Kansas, Maryland, Michigan, Minnesota, Missouri, Montana, Nebraska, New Mexico, New York, North Dakota, Oklahoma, South Dakota, Utah, Virginia, West Virginia and Wisconsin), 2 Canadian provinces (Alberta and Saskatchewan) in 15 years and has been detected in 5 species of deer in North America and 2 other species in Korea.

Due to the inability to “prove” the source from which wild deer have become infected, the definitive link between captive facilities and wild deer infections has not been documented. However, rather than spreading slowly through the resident population as observed in states that have monitored the disease, CWD appears to have spread by jumping from state to state (see map below, USGS 2011) suggesting that the disease has been spread by human movement of animals or infectious materials.



Distribution of Chronic Wasting Disease in North America, April 2011.

Ecological Impacts to Deer and Deer Populations

CWD is a highly contagious disease that is always fatal. Therefore, the potential to have CWD in either a free-ranging or captive cervid herd is extremely concerning to wildlife biologists and others interested in sound management of deer. The ecological cost of having CWD is difficult to accurately portray or predict. First detected east of the Mississippi in 2002, CWD is a relatively new phenomenon in the eastern U.S. Therefore, predicting the impacts of CWD on future population trends is challenging. Researchers must use available data regarding prevalence rates and rate of spread that is currently being observed in CWD-positive states to predict the potential outcome for deer populations in other areas. Computer modeling offers the best possible scenario for predicting the impact of CWD on deer populations.

Results of current modeling efforts using data from deer herds in states with CWD are sobering. These models generally show significant impacts to deer populations that may not occur until 25 to 50 years after they become infected and extinction of populations may occur in 100 years (Wildpro 2011). Almborg et al. (2011) suggested that disease prevalence and the severity of population decline depends on the duration that prions remain infectious in the environment. Once CWD exists in an area it is likely there to stay until such time as the prions no longer exist

in the environment. The length of time prions can persist in the environment is currently unknown, though indications are that they can exist for years depending on environmental conditions and soil types.

States in which the disease has been present for longer periods of time are beginning to see significant impacts. Currently, in Wyoming, where CWD was first documented in wild mule deer in 1985, researchers are examining the impacts of CWD on a mule deer herd with a high prevalence of the disease. Current reports from the Wyoming Game and Fish Department (WGFD) indicate that 49% of the mule deer herd is infected with CWD and the herd has decreased by 50% over the last 10 years. Research is underway to determine the role CWD in this population decline (WGFD 2011).

The length of time before CWD would significantly impact our native deer population if it occurred in North Carolina makes it difficult for biologists to portray the significance of this disease threat. However, most adults alive today will not likely see the end result of the effects of this disease on the deer populations that they now enjoy. Thus, resource managers must successfully explain to hunters, citizens, and policy makers the necessity of effective control measures to protect native deer resources.

Prevention and Control

The NCWRC conducts systematic statewide CWD surveillance on free-ranging whitetail deer every 5 years. During the 2003 sample period 1,488 samples were collected; during the 2008 sample period 1,403 samples were collected. Most of these samples come from hunter or automobile-killed deer. Note that samples are taken from whitetail deer exhibiting clinical signs of a central nervous system disorder whenever they occur regardless of the 5 year surveillance schedule. Also, all cervids that die in a pen are required to be tested for CWD.

At this time CWD is a non-treatable disease, limiting actions to those of controlling spread of the disease. Many factors contribute to the difficulty of controlling CWD, including:

- long incubation periods,
- difficulty in detecting early clinical signs,
- absence of a diagnostic test for live animals,
- an extremely resistant infectious agent,
- potentially long term environmental contamination,
- incomplete understanding of transmission mechanisms,
- high potential for translocation of the disease by humans,
- deer density and movement behavior, and
- concentrating animals by supplemental feeding and baiting.

North Carolina and other states that have yet to confirm the presence of CWD should continue to be diligent in their efforts to prevent the introduction of the disease using the following options:

Captive Herds

- Maintain strict control and monitoring or prohibition of captive herd facilities to prevent introduction of the disease or detect the presence as early as possible.
- If CWD is detected, affected facilities must be quarantined and depopulated.
- Exclude captive and wild animals from infected area(s).

Free-ranging Herds

- Protect wild populations by closely regulating or prohibiting captive cervid facilities.
- Prohibit or closely regulate importation of live deer.
- Prohibit intentional or unintentional importation of infectious materials.
- Maintain active surveillance programs to maximize probability of early detection.

If CWD is detected, states should:

- Implement a previously developed CWD Response Plan and amend as new information becomes available (NCWRC has a CWD Response Plan).
- Attempt to eradicate the disease if possible.
- Attempt to limit or slow expansion of the disease when eradication is not possible.

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Economic Impacts of Detecting Chronic Wasting Disease in North Carolina

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Hunting is big business in North Carolina. During 2006, 277,357 resident hunters spent \$488 million on retail purchases which generated \$818 million in economic output. These expenditures supported 8,332 jobs and contributed to \$46 million in state tax revenue. Of these, 197,220 resident deer hunters were an important part of this economic activity. They spent \$187 million on retail purchases, thereby generating \$322 million in economic output. These expenditures by deer hunters supported 3,408 jobs and contributed to \$20 million in state tax revenue. Deer hunters also spent \$50 million for travel-related expenses (Southwick Associates 2008). The detection of CWD and subsequent implementation of a CWD response plan in North Carolina would have significant impacts on North Carolina's hunting-based economies and jobs.

Detection of CWD would trigger the implementation of the North Carolina Wildlife Resources Commission's (NCWRC) Chronic Wasting Disease Response Plan (NCWRC 2006). However, political realities could greatly affect how the plan is implemented if CWD is detected within the state, because the direct economic impact to the NCWRC is dependent on the level of response to detection of the disease. While it is impossible to comprehensively estimate the exact overall economic impacts of the disease, there are several direct and indirect impacts that are likely to affect the NCWRC and other entities. Many variables ultimately determine the true economic impact of becoming positive for CWD. Important factors of consideration include, but are not limited to:

- the location in the state the disease is initially detected,
- disease prevalence rates at time of detection,
- the size of the CWD management area and ability to contain the disease,
- the NCWRC's ability to completely implement the CWD Response Plan,
- the duration of CWD management activities,
- the extent that captive cervid facility operators are affected, and
- hunter and non-hunter behavioral responses to detection of the disease.

Because of the nature of the disease and other biological factors, CWD has the potential to have significant long-term effects on the state's white-tailed deer resource, ultimately greatly reducing or eventually eliminating the population. The initial detection of CWD in North Carolina would begin a long path toward disease eradication or containment, unless circumstances facilitated immediate eradication or containment. The ultimate economic cost associated with the long-term presence of this disease may be a significant loss of hunters and their annual infusion of

dollars into the state's economy. Because sociological responses in North Carolina are unknown, these long-term effects cannot be adequately predicted and are not addressed herein. Our evaluations of costs focus primarily on short-term costs associated with initial detection of CWD as they affect various stakeholders.

Economic Impacts to the North Carolina Wildlife Resources Commission

One method to evaluate potential costs to the NCWRC is to examine costs incurred by state wildlife agencies that have experienced CWD. Two pertinent examples of agency response costs are from Wisconsin and Virginia. Wisconsin is a state where detection occurred after the disease had likely been undetected for an extended period of time. In Wisconsin, CWD appeared to occur over a large area and prevalence rates were high within the white-tailed deer population. Virginia represents a state that implemented their response plan immediately following detection of CWD in an adjacent state (i.e., West Virginia) and subsequently located a positive animal within their state. Because the detection in Virginia occurred before prevalence rates became high, Virginia was able to focus efforts and cost on containment in a smaller geographical area. These examples demonstrate the importance of early detection and response from both biological and fiscal perspectives.

Wisconsin Example:

Upon discovery of CWD in the Wisconsin the Wisconsin Department of Natural Resources took an aggressive approach in an attempt to stop the spread of CWD and originally hoped to eradicate the disease. Unfortunately, the discovery of CWD likely occurred too late and complete eradication is now thought to be unlikely in the highly endemic areas of the state. Nevertheless, Wisconsin spent approximately \$25 million dollars on CWD activities from 2002 through 2006 (Langenberg et al. 2009). Wisconsin's actions included sample processing, creating incentives for hunters that included monetary rewards, low-cost permits, and a program to donate venison to food pantries and utilizing agency employed sharpshooters to kill deer, which accounted for 5.2% of deer killed in 2004/05.

Virginia Example:

The Virginia Department of Game and Inland Fisheries (VDGIF) activated their CWD response plan in 2005 upon discovery of CWD in the adjacent state of West Virginia. Costs associated with activation of their plan were approximately \$70,000/ year and consisted of sample processing, equipment and other tangible goods. Implementing other portions of the VDGIF response plan when CWD was detected in Virginia in 2009, increased annual costs to \$180,000.00 (Matt Knox and Nelson Lafon, personal communication.). These costs do not include staff time, vehicle costs, and other personnel related expenditures. In contrast to Wisconsin, Virginia did not instigate hunter rewards, or utilize paid sharpshooters.

NCWRC has an active surveillance program and CWD response plan similar to those of the VDGIF. Therefore costs experienced by VDGIF are likely most representative of the direct financial impacts the NCWRC might incur provided there is early detection. In almost any scenario, the detection of CWD within North Carolina would put a tremendous strain on financial and employee resources within the NCWRC. Costs to the NCWRC can be categorized as either direct or indirect costs.

Direct costs associated with CWD surveillance and management would mostly include employee expenses associated with implementing the CWD Response Plan. Personnel would be needed to staff agency check stations, collect and submit tissue samples for testing, conduct deer sampling and removal/population reduction activities, conduct law enforcement activities, and provide associated support services. Other direct costs include procurement of all necessary supplies for agency management and surveillance activities, charges associated with testing of CWD samples, vehicle fuel and maintenance costs, and potential contract costs if USDA-APHIS-Wildlife Services is utilized to assist with deer sampling and removal/population reduction activities.

Indirect Costs associated with funding and personnel resources for CWD management and surveillance activities would be directly diverted from other agency programs. Therefore, becoming CWD positive would impact our ability to administer other programs to the possible detriment of other wildlife species and would directly affect services our agency provides to constituents.

A survey of deer hunters in 8 states and elk hunters in 3 states revealed that 2% of resident and 4% of nonresident hunters would stop hunting deer and elk if CWD was present at low prevalence rates (Vaske et al. 2005). However, if 50% of deer or elk were infected with CWD, 38% of resident and 52% of nonresident hunters would quit hunting those species. An even higher percentage (53% resident, 64% nonresident hunters) would stop hunting deer or elk if it was determined a hunter had died from CWD. After discovery of CWD in Wisconsin license sales declined 10% the following year. It is estimated that the NCWRC would lose approximately \$976,820 annually if 10% of deer hunters did not purchase hunting licenses due to detection of CWD within North Carolina (Clark 2010).

The potential loss of federal Pittman-Robertson (P-R) funds due to a decrease in deer hunter numbers and/or decreased deer hunter effort or interest could add further strain on agency resources and our ability to manage North Carolina's wildlife resources. The wildlife restoration component of the apportionment of P-R funds is based on the formula of 50% of land area plus 50% of the number of paid license hunters compared to the national total. If North Carolina's number of certified license holders goes down while most other states numbers hold steady or go up then we could receive substantially less of these funds.

The shifting of agency resources to CWD management and containment activities could also affect overall agency fiscal stability by creating a situation in which the agency is mandated to carry out actions that are or may be ineligible for federal funding (e.g., testing deer for hunter consumption, indemnifying depopulated captive herds, indemnifying farmers and retailers in CWD zones, etc.). In addition, due to strains on non-federal funds and staff resources, the agency may become unable to fully meet existing federal grant obligations or to obligate these funds to eligible activities. Lastly, it is possible that the agency's CWD management actions, perceived inadequacy in protecting the deer herd and potential diversion of resources from other agency programs, could erode public support for the agency. CWD management and containment actions could also lead to dissension within and among supportive constituent groups. Decreased support could lead to decreases in monetary resources (license sales, nongame tax write-off donations, sale of the agency magazine, and other purchases and contributions) as well as contribute to a decreased effectiveness in the agency's ability to manage North Carolina's wildlife resources.

Economic Impacts to Hunters

Hunters within the CWD management zone would suffer financial impacts if CWD were to be detected in North Carolina. In a fiscal note prepared in 2010 by the NCWRC, Clark (2010) estimated that hunters would incur a collective cost of approximately \$1,008 transporting deer to agency-staffed check stations within the minimum-sized (i.e., 5-mile radius) CWD management zone. Restrictions on the removal of certain deer carcass parts from the CWD management zone could result in collective costs to hunters of \$6,300 annually in meat processing and carcass disposal expenses. These expenses would increase proportionally as new CWD positive animals are detected, resulting in an increase in the size of the CWD management zone. There are other costs related to changes in hunter behavior that cannot currently be estimated or predicted. For example, many people may refrain from consuming deer meat resulting in additional costs for purchases of other meats. Removal of legal baiting, although involuntary, could actually reduce hunter costs though it might transfer those losses to retailers and/or local farmers. It is uncertain as to the impact on prices paid by hunters to lease hunting land. While there may be a few impacts that reduce hunter costs, they are far outweighed by those that increase hunter costs. Deer hunters will likely experience a loss of the recreational benefits of hunting. Recreational benefits are typically defined as the value of the recreational activity to the individual. Individuals often place a higher economic value on an activity than they actually spend to participate in that activity. It was estimated that Wisconsin deer hunters could lose between \$70 million and \$100 million in recreational benefits in one year (Bishop 2002). Applying the methodology described by Bishop (2002), North Carolina hunters could lose an estimated \$35 to \$54 million annually in recreational benefits if CWD were detected in the state.

Economic Impacts to Captive Cervid Facility Owners

Economic impacts that captive cervid facility owners may incur are highly variable and depend on the circumstances surrounding a positive diagnosis of CWD in the state. The NCWRC's fiscal note for the 2010 emergency powers rule proposal provides an analysis of the economic impacts to captive cervid facility owners in a worst-case scenario. In this scenario CWD is found in 3 large captive cervid facilities in close proximity to each other in Rowan County. The value of cervids lost by facility owners in this example was estimated at \$861,000.

Even if CWD is not detected in a captive cervid facility, the detection of CWD in free-ranging deer within North Carolina would directly affect captive cervid facility owners both within and outside the established CWD management zone. As indicated in the NCWRC's CWD Response Plan, the transportation of captive cervids for any reason within the CWD Management Zone would be prohibited. Under current NCAC rules this prohibition could result in economic impacts to captive cervid facility owners due to their inability to obtain a permit to transport captive cervids for veterinary treatment, slaughter for human consumption, transfer to out-of-state sources, or transfer to another captive cervid facility in North Carolina.

Other potential losses to captive cervid facility owners are impossible to estimate. If North Carolina becomes CWD positive it is likely that restrictions implemented by some other states and Canadian provinces will prohibit importation of North Carolina cervids into their jurisdictional areas. Therefore, the marketability and possibly the overall value of captive cervids will likely be reduced if CWD is detected in North Carolina.

Economic Impacts to North Carolina

Assuming a 10% reduction of deer hunting activity in the state caused by detection of CWD, it is estimated the impact to North Carolina's marketplace would be \$32 million annually (Clark 2010). These impacts would be a result of less hunting-related expenditures on equipment, transportation, food, lodging, and other hunting trip costs. At the local level, an important economic cost to the establishment of a CWD management zone would be related to the prohibition against baiting and feeding of deer. It is estimated that retailers would lose approximately \$60,480 in sales related to corn sold for use as deer bait in a minimally-sized (i.e., 5-mile radius) CWD management zone (Clark 2010). The loss of these sales would also result in an estimated loss of \$9,374 to local governments due to lost tax revenues. It is unknown as to the economic impact this might have on North Carolina farmers and wholesalers.

Individuals that enjoy wildlife viewing could lose recreational benefits from the occurrence of CWD in the state (Seidl et al. 2003), but it is impossible to estimate the actual economic impacts associated with those reduced benefits. It is believed that other economic impacts associated

with the general/non-hunting public will be relatively insignificant should CWD be detected within the state.

Estimate of Annual Economic Impact to North Carolina

The economic impact of detection of CWD in North Carolina will be significant. While quantifying that number is difficult due to the numerous variables as outlined above, a conservative estimate of cost is possible. Derived from information received from other states that have detected CWD, we conservatively estimate the annual cost following detection of CWD in one location within North Carolina is estimated as follows:

Estimated Direct Cost to the Agency (non-personnel):	\$180,000 (Virginia costs)
Estimated Direct Cost to the Agency (personnel):	\$200,000
Minimum Estimated Indirect Cost to the Agency:	\$976,820
Estimated Direct Cost to Hunters:	\$1,008
Direct Cost to Captive Facility Owners (worst case):	\$287,000 (per owner within the “hotzone”)
Estimated cost to the Economy:	\$32,000,000
Minimal Estimated Annual Cost to NC (actual dollars):	\$34,000,000*

*Does not include estimate of lost recreational value.

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Review of Statutes and Rules Concerning Captivity and Ownership of Cervids in North Carolina

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Holding wildlife in captivity raises multiple philosophical and legal questions. Herein, we discuss pertinent N.C. General Statutes (N.C.G.S.) and North Carolina Administrative Code (NCAC) rules related to national wildlife law and North Carolina’s wildlife laws/regulations as they apply to deer, the evolution of personal possession/ownership of wildlife, and the negative aspects of personal possession/ownership wildlife as it relates to deer health, deer management and the effectiveness of the North Carolina Wildlife Resources Commission (NCWRC) in managing the deer resources in our state.

The North American Model of Wildlife Management relies heavily on the concept of the Public Trust Doctrine. Derived from the 1842 U.S. Supreme Court case *Martin v. Waddell* the public trust doctrine is considered by most to be the foundation of North American wildlife law. Under the public trust doctrine wildlife is owned by no one but rather belongs to all citizens to be held in trust by the government for the benefit of present and future generations (Organ et al. 2010).

Assessment of the negative aspects of holding deer in captivity is complicated, largely due to variation in human opinions concerning private versus public ownership of wildlife, domestication of wildlife, commercial sale of wildlife, and “fair chase hunting.” These subjects are interrelated, making discussion of a single issue difficult. Other issues, such as disease implications and administrative costs, although somewhat unpredictable, are more evident and easier to quantify.

Definitions

To facilitate discussion and understanding of the terminology used within this document, several terms/concepts should be defined at the onset.

Captivity:	The containment of a wild animal within a human constructed physical barrier that prevents that animal from leaving a defined area.
Ownership:	The legal ability to purchase or sell an animal.
Possession:	Personal ability to control or restrict the movement of a live wild animal.

Cervid:	Members of the deer family.
Wildlife:	Wild animals and wild birds including species normally wild, or indistinguishable from wild species, which are raised or kept in captivity.
Captive Cervid Facility:	An enclosure licensed by the NCWRC in which cervids are held.

Review of Statutes Related to the Ownership of Cervids

N.C.G.S. § 113-131 articulates the legislative intent to maintain the premise of the public trust doctrine by stating clearly in the statute, *“The marine and estuarine and wildlife resources of the State belong to the people of the State as a whole. The Department and the Wildlife Resources Commission are charged with stewardship of these resources.”* N.C.G.S. § 143-239 then outlines the specific stewardship responsibilities of the NCWRC as, *“to manage, restore, develop, cultivate, conserve, protect, and regulate the wildlife resources of the State of North Carolina...”*

Possession and ownership were further addressed in N.C.G.S. § 113-291; outlining specifically that no person could - *“take, possess, buy, sell, or transport any wildlife – whether dead or alive, in whole or in part. Nor may any person take, possess, buy, sell, or transport any nests or eggs of wild birds except as so permitted. No person may take, possess, buy, sell, or transport any wildlife resources in violation of the rules of the Wildlife Resources Commission”* - clearly articulating the General Assembly’s original intent as it related to ownership of wildlife. However, with the introductory sentence of this statute, *“Except as specifically permitted in this Subchapter or in rules made under the authority of this Subchapter...,”* legislators offered the possibility that such actions could occur.

The issue of possession, transportation, and buying, selling, importing, exporting or otherwise acquiring live wildlife was further addressed by N.C.G.S. § 113-291.3 which states the NCWRC *“may impose necessary reporting, permit, and tagging requirements in regulating activities involving live wildlife and the nests and eggs of wild birds.”* This statement establishes the regulatory authority of the NCWRC over the activities related to live wildlife ownership.

It appears that the General Assembly first broached the subject of allowing possession and ownership of live wildlife in reference to furbearer and game bird propagation. Specific portions of N.C.G.S. § 113-273 outlined the legal ability of private individuals to own, propagate and sell certain live species of furbearers and game birds. This subchapter has evolved through time

specifically expanding this activity to allow individuals who hold a controlled hunting preserve operator license to buy and sell live game birds (except wild turkeys), fox (gray and red) and coyotes.

The General Assembly subsequently addressed the holding of wildlife in captivity in N.C.G.S. § 113-272.5 which authorizes the NCWRC to license qualified individuals to hold at a specified location one or more of any particular species of wild animal or wild bird alive in captivity. The introductory sentence of this section states that, *“In the interests of humane treatment of wild animals and wild birds that are crippled, tame, or otherwise unfit for immediate release into their natural habitat...”* implying that this section establishes a “Captivity License” for the purpose of rehabilitating wildlife or for the care of wildlife that cannot be released. It is important to understand that this section does not permit the ownership of these animals; it only authorizes licensed individuals to possess live wildlife.

While the possession of injured or otherwise non-releasable deer is authorized in N.C.G.S. § 113-272.5 it was not until passage of N.C.G.S. § 113-272.6 that the concept of NCWRC regulating the *“transportation, including importation and exportation, and possession of cervids, including game carcasses and parts of game carcasses extracted by hunters”* was firmly established in statute. The statute further allowed individuals who were otherwise illegally holding deer in captivity to apply for, and upon meeting certain conditions be granted, a captivity license to hold those deer so long as the person held the deer prior to May 17, 2002 and came into compliance with the rules established by the NCWRC by January 1, 2004. This section further states that *“any captivity license, captivity permit, or cervids held contrary to the provision of this section may be subject to forfeiture and disposition in accordance with the provisions of G.S. 113-137 or G.S. 113-276.2.”*

NCWRC Authority Related to Holding Cervids in Captivity

Through passage of N.C.G.S. § 113-272.6 the legislature established that cervids could be held in captivity provided certain rules as established by the NCWRC were followed. While the General Assembly provided legal opportunity for previously unlicensed cervid owners to become legal, it left licensing of future captive cervid facilities to the NCWRC.

The NCWRC subsequently adopted amendments to NCAC rules that specifically addressed the criteria for possessing cervids in captivity, the sale of cervids and transporting cervids within the State. 15A NCAC 10H.0301(a)(1) states that *“the possession of any species of wild animal ... or any member of the family Cervidae is unlawful unless the institution or individual in possession obtains from the NCWRC a captivity permit or captivity license as provided...”*. Currently, no new captivity licenses for cervids may be issued (15A NCAC 10H.0301).

Statutory authority to possess, import and export cervids in captivity is clear (N.C.G.S. § 113-272.6). One must assume that there is implied ownership of that animal for the purpose of legal commerce so long as the deer are possessed under a legal captive cervid license. That assumption is not supported, however, in statutory language. Subsequent NCAC rules appear to have established the concept of private ownership of cervids held within a licensed captive cervid facility. However, this ownership of cervids does not apply to unlicensed facilities, individual deer held with or without a captivity permit, or holders of a fawn rehabilitator permit.

Statute and rule allow captive cervid licensees the ability to determine the disposition of each deer within their facility as it relates to slaughter and exportation provided they apply for and receive appropriate permits related to each. State law prohibits releasing exotic species of wild animals in an area for the purpose of stocking for hunting and specifically prohibits the take of exotic species by hunting if they have been released for either purpose (N.C.G.S. § 113-292). Further, by rule, captive cervid license holders may not allow the hunting of any species of deer within their licensed facility (NCAC 10H.0301(c)(2)(C)).

It is currently legal for landowners to construct a fence around their property. The disposition of wildlife contained within such a fence is not specifically addressed in statute or rule. Deer contained within a high fence are essentially possessed by the landowner, but they remain a public trust resource. As such, the landowner may manage the deer herd using only activities that are legal if the fence were not there. Examples of those activities include management of animals through legal hunting and supplemental feeding. Although currently legal, containing deer in this manner restricts access to that resource by other citizens of the state by preventing normal movements and dispersal and, through selective harvest, may result in genetic differences.

Discussion

Established statutes and rules for licensed captive cervid owners appear to clearly articulate the conditions by which individuals can have cervids. These statutes and rules outline an individual's legal ability to hold, transport, and otherwise control the disposition of the deer within a licensed facility. They also clearly state the prohibition on hunting within licensed facilities. What remains controversial is the situation in which a landowner fences a property and contains deer within that fenced area. There is a thin line between possession and ownership of deer; obviously the deer are captive within the fenced property, however the property owner cannot sell, handle, import, or export those deer. Landowners in this situation are not required to hold a captivity license. It is illegal for a landowner to design a fence with a mechanism to entice or otherwise trap deer from outside the fence into the fenced area and the owner could be charged with both trapping deer and holding deer in captivity without a license.

Typically these landowners simply desire to manage the deer on their property through legal means. This appears legal in North Carolina and creates the situation in which private high fence facilities could exist, although certain prohibitions likely render their long-term persistence unlikely. The landowner is prohibited from charging a hunter to shoot a specific individual deer, however they can charge what is essentially an access fee to hunt the property. These “canned hunts” are typically viewed negatively by many hunters and most of the non-hunting public. Perpetuating these situations will most certainly lead to negative perceptions of the NCWRC, wildlife management, and hunters.

The passage of individual statutes that establish avenues for the privatization, commercialization, and domestication of wildlife slowly erodes the premise of the public trust doctrine. It is clear that the General Assembly’s original intent was that wildlife be a public trust resource and that the NCWRC was established and charged with the duty of protecting/managing those resources for all citizens. Through time, the Legislature has established a legal framework by which certain citizens may possess or even own certain wildlife species. Further expansion of this ability should include an evaluation of the original concept of public ownership of wildlife in North Carolina.

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Aspects of Holding Deer in Captivity

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Assessment of the various aspects of holding deer in captivity is complicated. This is largely due to variation in human opinion about private versus public ownership of wildlife, domestication of wildlife, commercial sale of wildlife, and “fair chase” issues. These subjects are interrelated, making discussion of a single issue difficult. Other issues, such as disease implications and administrative costs, although somewhat unpredictable, are clearer. In 2002, a technical review of the issues related to confinement of wild ungulates was prepared by an ad hoc committee of The Wildlife Society (Demarais et al. 2002). That review thoroughly covered all aspects of holding cervids in captivity and currently provides the most extensive coverage of the topic. In general, the wildlife profession considers most circumstances in which wildlife are held in captivity to be negative. Issues addressed by Demarais et al. (2002) included:

Biological Issues

- Behavioral Impacts
- Habitat Impacts
- Impacts on Non-ungulate Species
- Diseases and Parasites Associated with Confinement
- Genetic Diversity and the Management of Wild Ungulates

Social Issues

- Ownership of Wildlife Resources
- Hunting Ethics
- Public Perception of Hunting
- Commercialization and Domestication of Wild Ungulates
- Ecological Stewardship

While Demarais et al. (2002) presented an extensive review of this subject, we address below many of these issues as they relate to North Carolina. We encourage those persons seeking additional information to read the Wildlife Society’s technical review, *Biological and Social Issues Related to Confinement of Wild Ungulates*.

In the United States, deer are held in captivity for both commercial and non-commercial purposes. Non-commercial purposes include deer that are kept for educational and observation uses in private and public owned zoos and individuals that keep deer for personal enjoyment (i.e., viewing, genetic manipulation, etc.) or consumption. Captivity for commercial purposes

includes deer that are kept for a source of economic gain. Commercial purposes include raising deer for sale of meat, parts (i.e., hides, antlers, etc.), or sale of urine or gland secretions for lures, and economic gain from sale of breeding stock, reproductive material (i.e., semen), sale of hunts within the pen or, more specifically, sale of specific “trophy” animals that are shot by individuals. Some captive deer facilities may combine commercial and non-commercial purposes.

North Carolina has few deer held in captivity when compared to some states. The General Assembly and the North Carolina Wildlife Resources Commission (NCWRC) continue to receive requests to allow additional opportunity to hold deer in captivity, both from individuals and organized groups. It is important to understand that public desires related to this issue vary and range from individuals opportunistically obtaining a fawn deer and wishing to raise it as a pet to individuals desiring to hold deer in large numbers, often for commercial purposes. Regardless of the desire for holding deer in captivity the potential negative issues are the same.

Private Ownership of Wildlife

Holding deer in captivity and the resulting ownership of deer is a deviation from the principles of the public trust doctrine. Private ownership of wildlife is fundamentally a philosophical issue that becomes elevated to legal status as private ownership privileges are promulgated in state and federal law.

Holding deer in captivity provides a clear demonstration of how the issue of private ownership of wildlife can be blurred and confused. For example, in North Carolina a landowner may fence their property for any number of reasons. However, all resident wildlife species including white-tailed deer contained within that fenced area remain in public ownership. Thus while the landowner possesses these deer, they are not owned by the individual. In contrast, deer held in licensed enclosures appear to be owned by the licensee as they are legally allowed to dictate the sale and disposition of individual deer. In both cases, the state regulates what the individual may do with those deer. In the first example, the individual must abide by legal manner of take, while in the second scenario the state does not allow the individual to hunt or allow others to hunt the deer but may buy, sell, transport, import, and slaughter the deer with proper permits. These two examples demonstrate the subtle difference between possession and true ownership.

Disease Issues Associated with Holding Deer in Captivity

The two primary health issues concerning captive deer are increased incidence of density-related indigenous pathogens and the introduction of non-indigenous pathogens associated with imported deer and other animals. Indigenous pathogens that are likely to increase within confined deer herds include salmonella, ticks and tick-borne disease, pasturella, parasitic worms,

coccidiosis, e. coli bacteria, and clostridial infections (Stinson et al. 1999). Of greater concern is the introduction of pathogens not previously known to the region or to the species. The potential for movement of disease through movement of deer is well documented (Stinson et al. 1999, Brown and Bloss 1992, Buddle 1992, Heuschele 1982, Hutching 1992, Jessup 1985, Nettles 1992, Rickard et al. 1993, S.E. Coop. Wildl. Dis. Study 1994). Once introduced, pathogens can be further spread by movement of deer between enclosures and by infection of the free-ranging deer population. Of greatest concern is Chronic Wasting Disease (CWD), followed by tuberculosis, Johne's disease, as well as diseases not yet identified or detected.

Over time, CWD has the potential to decimate the state's white-tailed deer herd and it is currently its greatest known disease threat. The detection of CWD in North Carolina would result in significant economic, sociological, and ecological impacts to the state. Many states, including North Carolina, have established strict laws and regulations to prevent or control deer importation to minimize the potential for introduction of CWD into native deer populations.

Escape and Release of Cervids

The containment of any animal is accompanied by the inherent risk of escape or release, whether intentional or accidental. In addition to the disease threat associated with captive animals, the release or escape of exotic species often results in those species becoming naturalized. In North Carolina coyotes, feral swine, horses and nutria representing the most common mammalian examples.

The escape or release of exotic cervids and other ungulates has resulted in naturalized populations in numerous states. Examples in the southeastern US include: sika deer on Chincoteague Island in Virginia, sambar deer on St. Vincent's Island in Florida, fallow deer on the barrier islands of coastal South Carolina, and numerous species in Texas. Incidents of cervids escaping from captivity or being intentionally released have been observed in North Carolina. The captive cervid monitoring program has documented multiple occurrences of deer escaping or disappearing from licensed facilities. Fallow deer and Sika deer were reportedly released in at least two locations in coastal North Carolina approximately 25 to 30 years ago and animals continue to be observed in these areas. Individual deer of these species have also been observed in several other locations across the state. Although expansion of these populations has been limited, exotic species do range freely in various locations in North Carolina.

Escape and release of cervids that have become habituated to humans is another issue of concern. Deer that are kept in captivity for any period of time will become habituated to humans and generally do not behave as normal deer when released. They routinely approach people without fear and numerous examples of such deer are encountered annually in the state. When these deer

mature, especially males, they can become aggressive and endanger people. Documented human injury has occurred by deer that were raised in captivity.

Hunting Deer within Enclosures

A common purpose for keeping deer in captivity is to establish the ability to control certain aspects of deer biology through intensive management. Fencing is used to contain and manipulate deer and to control human access. By establishing control over which animals are harvested and who does the harvesting, the owner can manage deer numbers and sex ratio, and selectively leave or remove individual deer demonstrating specific genetic traits (e.g., antler size, body size, etc.). Deer enclosures of this type are commonly referred to as “high fence” operations and are best known in states such as Texas and Ohio. Several high fence enclosures reportedly exist in North Carolina, with the largest described as over 1,000 acres in size.

High fence management is primarily driven by the desire to grow superior quality bucks, often for economic gain. Financial gain may be realized by charging a fee to hunt within the enclosure, or charging a fee for killing a specific “trophy” deer. The facilities in North Carolina are thought to be constructed and utilized for personal rather than commercial purposes. Regardless of their intended use, the presence of such facilities and the perception of the public regarding these operations are of considerable concern to many sportsmen and the wildlife professionals of the state.

Surveys show that hunting for meat or population control is largely supported by the general public. However, hunting for the specific purpose of obtaining a trophy is not supported (Kellert 1980, Duda et al. 1998). Thus, shooting “trophy animals” in confinement is likely opposed by the majority of individuals. Allowing individuals to hunt deer inside a fence reinforces the negative stereotypical view of hunters and hunting often portrayed in the media and could lead to significant issues for wildlife management agencies as it relates to the use of hunting as a management tool as well as the recruitment of new hunters.

The Boone and Crocket Club, an organization founded by hunters in 1887, is dedicated to the concept of fair chase and requires the take of animals to meet specific standards for entry into their record books. Deer harvested within enclosures do not meet those fair chase standards. It is ironic that the Boone and Crocket score is typically the criteria by which commercial hunting facilities value the deer that hunters pay to shoot.

Commercialization of Wildlife

Allowing deer to be kept in confinement establishes the precedence of ownership which is a fundamental requirement of economic trade in wildlife and wildlife parts. Financial gain is most

commonly realized through the selling of meat, antlers (velvet antlers and shed antlers), breeding stock, semen, canned hunts, or the killing of a specific “trophy” animal. The ability to own and commerce in live captive wildlife is in stark contrast to the public trust doctrine. Not only is it the initial indicator of the privatization of wildlife but it is also the first step toward their domestication.

Current North Carolina law allows captive cervid license holders to conduct all of the above activities with the exception of hunting. This prohibition on hunting includes charging fees to hunt or harvesting specific animals within their licensed facility.

Biological Issues

Fencing prevents natural movements of deer, both those within the fence and those outside. Natural dispersal of bucks provides essential genetic exchange and preventing this dispersal may result in reduced genetic variability among deer within enclosures. Price et al. (1979) reported that genetic variability in two enclosed populations of white-tailed deer in Arkansas was 50% lower than that of a free-ranging population. Genetic manipulation of deer within enclosures, accomplished by selective harvesting / breeding and importation, may lead to deer that are genetically different than those of the natural population surrounding the enclosure. Significant fencing within a specific area may also obstruct the movements and genetic exchange of free-ranging wild deer and restrict the movements and habitat use of other species.

Obviously, deer numbers within an enclosure are limited by the amount and quality of available habitat within the enclosure. Most enclosure operators compensate for these limits by removal of animals and by providing supplemental nutrition. If these limits are not addressed, deer health and condition deteriorate rapidly within the enclosure. Issues related to health and condition are most commonly observed in deer pens where the owner’s primary issue is to confine the deer for personal enjoyment and have little understanding of proper animal husbandry practices. These situations raise significant issues related to animal welfare and ethical treatment.

Costs Associated with Regulating and Administrating the Captivity of Cervids

Irrespective of the issues described above, the regulation and administration of captive deer facilities results in a financial cost to North Carolina and potentially the federal government. Ultimately, the cost depends on which activities are legal or specified as illegal, and, the extent that other negative issues are selected to be avoided, managed, or minimized. Excluding the cost of CWD being detected in North Carolina, a short list of these activities includes:

- Issuance of licenses, permits, and maintenance of records,

- Personnel and equipment cost associated with facility inspection, monitoring, and compliance (pertaining to husbandry and facility compliance) and cost associated with response to illegally held deer,
- Compliance with food safety laws and rules that regulate captivity of animals held for human consumption and meat or other products sold to the public,
- Testing of animals demonstrating clinical symptoms of CWD and other diseases,
- Technical guidance to facility owners and operators,
- Monitoring and enforcement of intrastate and interstate movement of animals,
- Development and maintenance of statutes and rules,
- Application and enforcement of hunting regulations within enclosures and the sale of “canned hunts”,
- Response to the public regarding questions and issues about captive deer facilities, and implications for natural movements of wild animals, and
- Potential legal expenses and expenses for responding to Public Record requests associated with animals held in captivity.

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