

ABSTRACTS – Listed by Sessions

SESSION I

Chronic Wasting Disease Symposium Opening Remarks

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The spread of chronic wasting disease (CWD) is an issue of national concern and the U.S. Department of the Interior is committed to supporting the states in their efforts to combat the disease. State wildlife management agencies are clearly on the front line of this issue, having been involved in efforts to study, control, and eradicate CWD since the 1960s. Department of the Interior, Secretary Gale Norton, recognizes the national significance of CWD to both wildlife populations and State economies, and she realizes that combating this disease will require a coordinated and cooperative effort by State and Federal agencies. To this end, she has asked me to be the Interior Department's point person on the issue. As an avid hunter, former professional deer biologist and administrator with several state wildlife management agencies, I understand the wildlife issues involved and I appreciate the impact that CWD is having on the states and on the hunting community. The Department is committed to working closely with the Department of Agriculture and the States to develop the information and techniques necessary for the control and eradication of this disease in free-ranging and captive cervids. I have joined with APHIS Administrator Bobby Acord to inaugurate and co-chair the Chronic Wasting Disease task force. Together, some of the most knowledgeable and experienced professionals working on CWD from the Federal government, States, and Universities developed a report recommending actions to assist states, federal agencies, and tribes in their efforts to manage CWD. Experts from the Interior and Agricultural Departments and from state agencies have been called together to develop an Implementation Plan that will set in motion the actions recommended by the task force. We believe that continued cooperation, communication, and collaboration will provide the tools needed to combat the spread of this devastating disease.

Prion Diseases: Overview of General Concepts

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Chronic wasting disease (CWD) of cervids belongs to a group of fatal transmissible neurodegenerative disorders caused by prions. The origins and the mode of transmission of CWD remain unclear. It is also unknown whether there are different strains of CWD prions or whether CWD poses a risk to other animals or humans. Understanding the risk that CWD poses to humans is of paramount importance in light of evidence that a variant of Creutzfeldt-Jakob disease (CJD) in humans, known as vCJD, results from exposure to prions from cattle with bovine spongiform encephalopathy, or 'mad cow disease'. The mechanism of prion replication is unique, the central event being the coercion of host-encoded prion protein (PrP^C) by the disease-associated isoform (PrP^{Sc}) to adopt to the infectivity-associated conformation. We will provide an overview of the human and animal prion disorders and review our current understanding about the mechanism of prion propagation including the molecular basis of prion species barriers and prion strains.

Chronic Wasting Disease of Deer and Elk: An Overview

Elizabeth S. Williams, University of Wyoming

From an obscure disease affecting a few mule deer in a small western town and of interest only to a handful of biologists to a disease affecting free-ranging and farmed big game animals from western North America to Korea and of international interest, CWD has become a significant issue for wildlife managers, public health officials, hunters, agricultural industries, researchers, and the general public. Chronic wasting disease is not a new disease. Based on observations and research over the last three decades much has been learned about CWD. We have some understanding of pathogenesis, natural host range, and epidemiology, and there are good diagnostic techniques; these will be discussed in detail throughout this symposium. However, we need to know more about all of these subjects, and, most importantly, we need to develop techniques to manage and control this disease.

Chronic Wasting Disease Surveillance and Monitoring Strategies: An Overview

Michael W. Miller, Colorado Division of Wildlife

Surveillance systems for chronic wasting disease (CWD) in free-ranging wildlife evolved in the absence of regulatory or economic pressure. To date, the motivations for reliably estimating distribution and prevalence of CWD in native wildlife populations have been twofold: scientific curiosity, accompanied by a sense of responsibility for acquiring *and conveying to the public* accurate information about this disease and its occurrence in public resources. In this environment, three somewhat distinct approaches to CWD surveillance have evolved and are currently in use in varying combinations. An appreciation of the details and applications of each is important in interpreting data on CWD status.

Surveillance for clinical suspects, commonly termed “targeted surveillance”, has been used effectively to detect new foci of CWD infection in free-ranging cervids. Under such systems, “suspects” displaying clinical signs consistent with CWD are sampled whenever available. Histopathology of brainstem is usually sufficient to diagnose cases, but immunohistochemistry (IHC) is a valuable adjunct in many cases. Targeted surveillance data are clearly biased, and consequently are of little use in estimating prevalence. This approach is very similar to traditional scrapie surveillance in the US, and has been used to detect infected elk farms throughout North America.

Surveillance can be extended to all natural mortalities, or to all mortalities regardless of proximate cause. This “mortality-based” surveillance also is an effective tool for detecting new foci of CWD infection. As in targeted surveillance, histopathology of brainstem is usually sufficient to diagnose cases, but IHC is a valuable adjunct. Inherent biases in mortality-based surveillance data limit their use in estimating prevalence. This approach is considerably more aggressive than traditional scrapie surveillance in the US. A growing number of states and provinces also have adopted this approach in rules that regulate their elk industries, resulting in the disclosures of several infected elk farms over the last few years.

Techniques for geographically-targeted random sampling of harvested deer and elk (“harvest-based” surveys) have been developed over the last decade to estimate CWD prevalence and monitor trends. In these surveys, sections of brainstem (medulla oblongata at the obex) and, more recently, tonsil or retropharyngeal lymph node are collected and examined via IHC; infections can be staged assessing staining distribution and by histopathology. Data from these samples represent relatively unbiased point estimates of CWD prevalence. Comparable slaughter survey data for scrapie and BSE have not been reported formally, confounding comparisons of epidemic severity between CWD and, for example, scrapie in the US. This lack of comparable data has perhaps fostered misperceptions about CWD.

Using various combinations of these 3 surveillance approaches, wildlife managers have developed a good basic understanding of CWD’s status in North America, as described in the reports that follow.

Distribution and Occurrence of Chronic Wasting Disease in Colorado

Michael W. Miller, Colorado Division of Wildlife

Surveillance of free-ranging cervids for chronic wasting disease (CWD) has been ongoing in Colorado since the late 1970s. Before 1991, targeted surveillance was the only approach used by the Colorado Division of Wildlife (CDOW) to monitor CWD; this approach continues to be our most efficient means of detecting new foci of infection throughout the state. Since 1991, however, annual harvest-based surveys have become equally important in attempts to estimate prevalence and monitor epidemic trends. Ongoing surveillance conducted by the CDOW has shown that, to date, CWD is found in free-ranging deer and elk herds in northeastern Colorado and in free-ranging mule deer in a portion of Routt County in the northwest part of the state. Since 1996, the CDOW, in cooperation with the University of Wyoming and Colorado State University, has examined more than 3,000 “suspect” and harvested deer and elk from throughout the state, including each of the large mule deer herds on the Western Slope. With the exception of the Routt County finding, none have been infected with CWD. In addition to this statewide sampling, the

Division also has examined more than 8,500 deer and elk harvested or culled in endemic portions of northeastern Colorado. Estimated prevalence in mule deer harvested from the 19 northeastern endemic game management units (GMUs) through 2001 averages about 5% overall, and ranges from <1 to 11%. Estimated prevalence in elk residing in corresponding GMUs averages <1% overall. Observed trends suggest both prevalence and distribution of CWD in mule deer has slowly increased over the last decade in northeastern Colorado. In order to communicate current information to interested publics, CDOW provides regular updates on surveillance and other CWD-related activities on a publicly accessible web site (<http://wildlife.state.co.us/CWD/chronicupdate.asp>).

Distribution and Status of Chronic Wasting Disease in Wyoming

Terry Kreeger, Wyoming Game and Fish Department

The Wyoming Game and Fish Department has conducted intensive hunter surveillance for CWD since 1997. Deer and elk heads are primarily collected from meat processors and taxidermists within the endemic area of southeastern Wyoming. Brain samples and lymph nodes are examined microscopically and by immunohistochemistry. Since 1997, the prevalence of CWD in the core endemic area was 12% in mule deer, 16% in white-tailed deer, and less than 3% in elk. While CWD appear to be expanding its range within Wyoming, annual prevalence rates have not increased.

Distribution and Status of Chronic Wasting Disease in Nebraska

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The Nebraska Game and Parks Commission begin surveillance for Chronic Wasting Disease (CWD) in the fall of 1997. Since that time, over 2,900 wild deer and 150 wild elk have been tested for CWD. Three positive free ranging mule deer have been diagnosed in Kimball County, 1 positive mule deer in Cheyenne County, 1 positive white-tail deer in Scotts Bluff County and 9 positive white-tail and 1 positive mule deer from Sioux County.

The regulation and testing of captive cervids in Nebraska is conducted under the authority of the Nebraska Department of Agriculture. They have recently instituted a mandatory CWD testing program and prohibit the importation of any cervid that has not been part of a CWD monitoring program for a minimum of 60 months. Additionally, the importation of cervids from any county that has had a positive case of free ranging CWD is prohibited. There have been three captive facilities with positive CWD results since 1997. The first case was on an elk ranch in Cherry County. This facility was monitored for three years and declared CWD free in 2001. The second was an elk facility in Cheyenne County. This facility had a total of 4 positive CWD elk and was depopulated in 2001. The third facility is in northern Sioux County and had 4 positive animals from December of 2000 to March of 2002. Additionally, a pen constructed on this facility, adjacent to the elk pen, enclosed several free ranging white-tail deer and 11 of 21 hunter harvested deer inside this pen were positive. The NGPC depopulated the deer pen and 170 additional white-tail deer were removed. Of these, 87 more CWD positive animals were discovered. The elk pen was depopulated in early 2002 with 74 elk removed with 7 additional positives.

NGPC will continue to conduct hunter harvest surveillance throughout the state, concentrating on the Panhandle area. During the 2002 firearm deer hunt, all animals harvested in the Panhandle will be tested under a voluntary submission program and we will test a minimum of 100 samples from all other Deer Units in the state. Estimated number of animals to be tested this fall is 3,500.

Wisconsin's Chronic Wasting Disease Surveillance Program for Wild White-tailed Deer

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Chronic Wasting Disease (CWD) is a progressively degenerative and fatal neurologic disease in deer (*Odocoileus* spp.) and elk (*Cervus elaphus*), thought to be caused by a transmissible protease resistant prion protein. Prior to Fall 2001, CWD had been diagnosed in free-ranging deer and elk

in Colorado, Wyoming, Nebraska, and Saskatchewan. The Wisconsin Department of Natural Resources (WDNR) has had a surveillance program for CWD in wild white-tailed deer (*O. virginianus*) since 1999. The program has included targeted sampling of deer over 18 months of age showing signs compatible with CWD, such as poor body condition and abnormal behavior. Additional sampling has been done from deer over 18 months of age collected by hunters or sharpshooting teams. Hunter harvested deer were sampled from areas of the state chosen based on the following criteria: (1) presence of elk farms which had received elk from CWD infected Colorado or Nebraska farms, (2) high density of cervid farms and wild deer, or (3) areas being considered for establishment of new wild elk populations. Brainstem samples were removed from the deer at registration stations, and then submitted to the National Veterinary Services Laboratory (Ames, IA) for immunohistochemical detection of the CWD protease-resistant prion. From 1999-2001 approximately 1000 deer were tested statewide for CWD. Three hunter harvested bucks, 2 ½ - 3 ½ years of age and shot within three miles of one another during the 2001 hunting season, tested positive for CWD. One of these three deer had clinical signs compatible with CWD. Identification of CWD in these 3 free-ranging Wisconsin deer was the first detection of this disease east of the Mississippi River. CWD is of great concern in Wisconsin due to the state's high deer densities, agricultural and land use patterns, and recreational importance of deer hunting.

South Dakota Surveillance and Monitoring Program

Ron Fowler, South Dakota Department of Game, Fish and Parks

Game, Fish and Parks (GFP), in cooperation with South Dakota State University, tested heads of hunter-harvested animals collected from meat processors in 1997, 1998, and 1999. The sample included 368 elk in the Black Hills, and 519 white-tailed deer and 128 mule deer from across the state. None were found to have CWD. Emphasis was placed on testing elk and deer from areas near previously quarantined CWD private elk herd sites.

No testing was done in 2000. GFP resumed testing of hunter-harvested deer and elk in 2001, primarily in the southwestern portion of the state. Animals tested consisted of 166 elk, 95 mule deer and 241 white-tailed deer. A single white-tailed deer from that investigation, which was taken in Fall River County of extreme southwestern South Dakota, tested positive for CWD. Subsequent surveillance conducted in early 2002 involved testing of 2 elk, 111 mule deer and 63 white-tailed deer. None of these animals tested positive for CWD. As of June 2002, 1,693 wild deer and elk have been tested for CWD in South Dakota with only the one white-tailed deer found to have the disease.

South Dakota agencies, in cooperation with citizens of the state, will continue to keep a close watch for the disease and determine its distribution and prevalence. This program will incorporate testing of hunter-harvested deer and elk, as well as sick deer and elk that are found and reported to GFP.

Distribution and Status of Chronic Wasting Disease in Saskatchewan

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Saskatchewan initiated a Chronic Wasting Disease (CWD) surveillance program of wild deer and elk in 1997, following the discovery of an infected game farmed elk in the province. Between 1997 and 1999, obexes from 283 deer and 46 elk were examined histologically for CWD using immunohistochemistry and all were negative. Samples were primarily from hunter-killed animals, but included some samples obtained incidentally.

Following identification of the CWD source herd and eight additional trace out herds in 2000, Saskatchewan Environment (SE) launched an intensive wild deer and elk surveillance program targeting wildlife management zones surrounding the captive CWD source herd. Sampling in this area was designed to have a 95% probability of detecting at least one CWD positive animal assuming a prevalence of 0.5%. Hunter-killed samples also were tested from the remainder of the

province. From the 2000 hunter harvest, one 3 year old, male, mule deer from wildlife management zone (WMZ) 46 in the targeted surveillance area tested positive for CWD. In May of 2001, SE staff harvested 213 deer, 128 from a 20 x 20 square mile area surrounding the location of the first positive case and 85 from a 20 x 20 square mile area around the captive CWD source herd. One 4-year-old male mule deer harvested less than 4 miles from the first CWD case tested positive.

For 2001 an intensive surveillance area comprised of 10 WMZs surrounding the infected area ((herd reduction area (HRA)) and high risk CWD infected captive facilities ((high priority areas (HPA's))) was identified. The HRA was a 10 mile wide band around the two positive cases in zone 46 and the HPA's were approximately 20x 20 square mile areas around the captive facilities. The remainder of WMZ 46, around the HRA was also identified as a high priority testing area. Sampling was designed for a 95% probability of detection of at least one positive animal, assuming a prevalence of 0.5% province wide, within the intensive surveillance area, within HPA's. The objective for the HRA was to reduce the population by 60%. All regular and draw hunting seasons were closed and hunters were issued special CWD control permit for WMZ 46. Special CWD permits were also issued to hunters in the HPA's. Mandatory head submission was a requirement for all hunters using the free control permits. All 2001 hunter-killed deer and elk samples were negative for CWD. Beginning in the fall of 2001 only obex samples which clearly contained the vagal nucleus were classified as negative; whereas in previous testing some samples would have been classified as negative without a vagal nucleus being present thereby reducing the sensitivity of the test. Sampling was adequate to have a 95% probability of detecting at least one positive animal assuming a prevalence of 0.5% province wide and within the intensive surveillance area. However sampling was inadequate within the HPA's. In 2001, assuming similar susceptibility of mule deer and white-tailed deer to CWD, sampling across the province was adequate for detection of CWD at a prevalence of 0.1% and within the intensive surveillance area assuming a prevalence of 0.2%. In spring 2002 SE harvested 185 deer from the HRA in WMZ 46 and an additional positive case was detected less than 4 miles from the second case. These data suggest that CWD is at a very low prevalence in wild deer within our intensive surveillance area.

National Chronic Wasting Disease Surveillance: Accomplishments and Needs

John Fischer, Southeast Wildlife Disease Cooperative

Temporal and Spatial Dynamics of Chronic Wasting Disease Epidemics

Michael W. Miller, Colorado Division of Wildlife

Epidemics of chronic wasting disease (CWD) occur naturally in captive and free-ranging and elk populations. Although some specific details about the CWD agent and its mechanism(s) of transmission among and within cervid populations remain uncertain, several insights have been gained from observing and modeling epidemic dynamics in affected deer and elk populations. Remarkably high rates of infection can arise in both captive and free-ranging populations; rapid increases in prevalence within captive herds suggest transmission may be quite efficient, at least on a local level. Direct and/or indirect, animal-to-animal transmission drives CWD epidemic dynamics; although having an infected dam may intensify exposure and perhaps shorten the disease course somewhat, maternal transmission alone is insufficient to sustain epidemics. Environmental contamination appears to play a role in both sustained and recurrent epidemics. Both epidemic models and experiences with captive deer suggest a stable coexistence between CWD and affected host populations is unlikely, and that unmanaged epidemics may cause localized extinctions. Natural geographic spread of CWD has probably been effected by dispersal and/or migratory movements of deer and elk from infected to uninfected subpopulations; field data from northeastern Colorado suggest that seasonal migration patterns may be most influential in at least one area. Geographic differences in current CWD prevalence among infected free-ranging populations support models of diffusion-type spread along natural migration corridors; such observed differences may be useful in estimating rates of natural spread. Spatial models parameterized with field data also may be useful in forecasting rates and likely paths of natural spread.

Chronic Wasting Disease Modeling in Wisconsin

John Cary, Department of Wildlife Ecology, University of Wisconsin-Madison

The Wisconsin Interagency Health Team, formed in response to the recent discovery of CWD in Wisconsin, is currently using a large-scale spatially-explicit individually-based model to assist them in understanding the system they are now charged with managing. The extent of this model (72 mi x 72 mi) approximates the actual extent of the CWD-focused management effort as it is currently defined in Wisconsin. Spatial resolution of the model is a quarter-section (0.25 sq mi, 160 ac, 64 ha). A maximum of 300,000 deer can be followed individually through model time to generate population and disease dynamics and spatial distributions. The major model timestep is the season (quarter year), but daily timesteps are employed within various hunting seasons. The model features several individual-based spatially-explicit submodels that restrict the key demographic processes to localized social interactions among deer and between deer and hunters. Key submodels include: CWD transmission among individuals, the dispersal process (which is also the primary mode of spreading CWD on the model landscape), gene flow through mating, and how probability of being killed by hunters depends on local hunter numbers and hunting practices. Submodels for population estimation, CWD testing, and herd management are also included and are implemented on an annual timestep. Model outputs have proven useful for estimating the rate parameter for CWD transmission, and for visualizing and communicating outcomes of alternative management strategies.

SESSION III

Distribution and Status of Chronic Wasting Disease in Farmed Cervids in the USA

Lynn H. Creekmore, USDA, APHIS

CWD was first detected in farmed animals in the US in 1997 in an elk herd in South Dakota. Since then the disease has been identified in 23 additional farmed elk herds in a total of six States (CO, KS, MT, NE, OK, SD). These herds were discovered through routine surveillance, tracing and depopulation efforts. Since 1998, twenty of these herds have been removed. About half of these were depopulated in the past ten months with the use of USDA funds. In addition to these positive herds, USDA assisted in the depopulation of elk herds within the endemic area of Colorado. Of the three remaining herds, one in Nebraska has had its quarantine lifted after more than four years of surveillance with no further evidence of the disease. A second herd in Colorado is being reviewed for inclusion in a State research program. A third, in Oklahoma, is negotiating over compensation.

USDA is continuing to work with the States and the farmed cervid industry to develop a CWD herd certification program in the US. This program aims at improving surveillance for CWD in farmed cervids and eliminating the disease where it is found. It is patterned on programs being implemented in approximately twenty States. The program will include farmed elk, white tailed deer, mule deer and red deer. Assuming funding becomes available, USDA plans to implement this program in 2003.

Distribution and Status of Chronic Wasting Disease in Farmed Cervids – Canada

Lynn Bates, Canadian Food Inspection Agency

Distribution and Status of Scrapie

Dianne Norden, USDA, APHIS, VS, CEAH

Diagnosis of Chronic Wasting Disease in Deer and Elk: An Overview

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Chronic wasting disease (CWD) is a family of disorders affecting members of the Cervidae group, including mule deer, white tailed deer, and Rocky Mountain elk. CWD has been reported in elk raised on game farms and in free ranging deer and elk in limited parts of the US. Diagnosis of CWD is typically made by examining the brain for PrP^{CWD}, the protein marker for the disease. Sensitive, specific methods for detection of PrP^{CWD} by immunohistochemistry (IHC) have been described and this assay remains the gold standard for CWD diagnostics. However, IHC is time consuming, expensive, and requires the skills of a pathologist for interpretation. Preliminary screening of tissues in microplates has been proposed for increasing the efficiency of large scale surveillance. Microplate test evaluation, licensing, and evaluation trials are underway. Relative sensitivity, specificity, throughput, technical demands, and cost are factors in development and implementation of diagnostic tests for CWD. A variety of test formats suitable for the needs of game management, agricultural regulatory, research, and hunter groups may eventually be approved for use in the US and Canada.

Detecting Chronic Wasting Disease Infections in Live Animals

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A practical, reliable, and inexpensive test for detecting chronic wasting disease (CWD) infections in live deer and elk would be a valuable management tool in both free-ranging and captive settings. Several potential avenues of testing, including examination of blood, lymphoid tissue biopsies, and urine for evidence of CWD infection, have been evaluated with varied rigor. To date, immunohistochemistry (IHC) on biopsies of tonsillar tissue is the only approach that has been successfully applied in diagnosing CWD in free-ranging and captive mule deer; similar success has been observed in limited evaluation of free-ranging and captive white-tailed deer. Tonsillar biopsy IHC appears to be of limited potential use in elk because lymphoid accumulation of PrP^{res} occurs relatively late in the course of CWD infection in this species. Because tonsillar biopsy in deer requires anesthesia, specialized equipment, and specific technique to assure that usable samples are obtained, its practical application as a management tool is somewhat limited; moreover, dependence on IHC for diagnosis currently precludes application as an on-site or animal-side test. Although tonsillar biopsy IHC is now being applied in select research and management settings, development and evaluation of more practical and rapid live-animal tests to screen for CWD infection should be encouraged.

Validation of Two Commercially Available Bovine Spongiform Encephalopathy (BSE) Rapid Screening Tests for Screening of Chronic Wasting Disease (CWD) in Brain and Lymphoid Tissues

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The current diagnosis of Chronic Wasting Disease (CWD) depends on the recognition of specific neuroanatomical immunohistochemical staining (IHC) patterns of the proteinase-resistant prion protein (PrP^{CWD}) in brain and lymphoid tissue of affected animals. There are several limitations to this diagnostic technique which is currently hampered the effectiveness and cost of a practical surveillance program for both free-ranging and captive cervids. Specifically rapidity, accuracy, and volume capacity are key elements in the selection of tests for a surveillance program. Therefore, there is a need to explore rapid screening tests to complement the available techniques as well as to allow large volume screening for this disease. Several tests currently exist for the diagnosis and screening of Bovine Spongiform Encephalopathy (BSE) in cattle. These tests have been validated and are currently being applied in the control program for BSE in Europe and other countries.

The objective of this presentation is to report the findings from a study conducted to validate commercially available screening tests for BSE for their ability to screen for CWD among hunter-killed deer and elk. Two commercial companies (BioRad and Prionics), have agreed to participate in this study. This validation will be the first step in assessing potential screening tests for this disease, with the ultimate goal of improving the preventive measures for its spread.

Approximately 260 samples of brain tissue from deer and elk and 15 lymph nodes were used for this validation. These samples were collected by the Colorado State University Veterinary Diagnostic Laboratory mainly from the volunteer program, where samples were submitted from deer and elk killed during the 2001 hunting season in Colorado (September 2001 through February, 2002). All these samples have been tested by IHC and the results were available for this study. Prior to testing, each sample was homogenized in order to increase the likelihood that all assays were performed on comparable samples by equally distributed prion proteins, if present. All tests were performed at the Animal Population Health Institute (APHI) Laboratory at Colorado State University. The two involved companies agreed to conduct training sessions with the laboratory technical staff on using the equipment and conducting the tests. Homogenized samples were tested again by IHC using standard staining protocol. Each company proposed and used two tests: a primary test as a screening test, which is ELISA-based procedure and a confirmatory test which is a Western blot method. Samples were stratified according to test results, including IHC results. Sensitivity and specificity for each test were calculated using the IHC results as the gold standard. The 95% Confidence Intervals were calculated for each of the sensitivity and specificity estimates. Data are currently being analyzed and a summary will be presented.

Comparison of Lesions in Free-Ranging Mule Deer with Naturally-Occurring Spongiform Encephalopathy with those of Chronic Wasting Disease in Captive Mule Deer and Distribution Patterns of PrP^{res} in Brain and Palatine Tonsil of Non-Clinical Mule Deer with Chronic Wasting Disease

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Histologic lesions and immunohistochemical staining (IHC) was found in 16 free-ranging deer with spongiform encephalopathy (SE) and in ten captive deer with chronic wasting disease (CWD), but not in 12 free-ranging deer without SE. Lesions were found throughout the brain. IHC was found throughout the brain, retina, and in lymphoid tissue of deer with SE and CWD. Lesions and IHC staining did not occur in any other system. This comparison is evidence that these two diseases are indistinguishable morphologically.

The distribution and pattern of prion protein PrP^{res} was determined in 35 hunter-killed deer infected with CWD but not showing clinical signs of the disease. Based on the location and abundance of IHC and the location and severity of SE, deer were placed into four categories. Category 1 (n=8) had IHC in the palatine tonsil but no evidence of IHC or SE in the brain. Category 2 (n=13) had IHC in the palatine tonsil and positive IHC with or without SE in the dorsal motor nucleus of the vagus nerve (DMNV). Category 3 (n=2) had IHC in the palatine tonsil, IHC with SE in the myelencephalon, and IHC without SE in the hypothalamus. Category 4 (n=12) had IHC in the palatine tonsil and IHC with or without SE throughout the brain. The 12 deer in Category 4 could be divided into three subgroups: 4-A (mild=5 animals), 4-B (moderate=4), and 4-C (severe=3). The differences in these three subgroups were the prevalence and abundance of IHC and location and severity of SE in the telencephalon, mesencephalon, metencephalon, and spinal cord. IHC was detected in specific neuroanatomical sites in which SE was not found. IHC in tonsil and brain, and histological lesions of SE were not detected in brain of 208 negative control deer. Category 1 may represent early lymphoid tissue localization of PrP^{res} deposition in deer with CWD. The DMNV appears to be the most consistent single neuroanatomical site of detectable PrP^{res}. Categories 2 and 4 may represent a progression of spread of PrP^{res} and SE throughout the brain.

Can Transmissible Spongiform Encephalopathy Diseases of Ruminants Be Distinguished Based on PrP-res Glycoform Profiles

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The likely transmission of bovine spongiform encephalopathy (BSE) to humans changed the way people view animal TSE diseases from simply agricultural problems to problems having potential human health consequences. Identifying the specific source of transmissible spongiform encephalopathy (TSE) in a given situation could help assess risk and allow formulation of response protocols. In Europe scientists have used analysis of abnormal prion protein (PrP-res) glycoforms to differentiate sheep infected with scrapie from sheep infected with BSE. Results have been inconsistent. However, in rodent models of TSE disease such analyses have been reliable and useful. Therefore, we analyzed PrP-res patterns from TSE-affected ruminants to determine if any species-specific profiles could be identified. Some differences were observed especially when BSE was compared to some of the other species. Unfortunately, the differences among deer, elk, and sheep were not remarkable enough to identify specific TSE diseases.

Production and Preliminary Characterization of Transgenic Mice for Studying Chronic Wasting Disease

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Expression of foreign prion protein (PrP) genes in transgenic mice has been an extremely effective means of studying human and animal prion diseases. We have therefore developed transgenic mice expressing cervid PrP or chimeric mouse/cervid PrP for the rapid and sensitive detection of CWD prions. We present the results of our studies on the generation and preliminary characterization of these transgenic models. Ultimately our studies will provide the first reliable assay for detecting infectious CWD prions and will provide crucial information about CWD prion species barriers. Transgenic mice are also being used to investigate the prevalence of CWD prion strains in captive and wild populations of mule deer, white tailed deer and Rocky Mountain elk and to assess the effect of cervid PrP polymorphisms at codons 129 and 138 on CWD susceptibility. We will also use transgenic models of human and bovine prion diseases as a means of determining the risks that CWD prions pose to humans and livestock. The study of intermammalian species barriers in transgenic mice will allow more accurate assessments of the risks posed to humans and livestock from exposure to CWD prions. More generally, these studies will further our understanding of the molecular mechanisms of prion pathogenesis that will ultimately result in rational approaches to therapies for human and animal prion diseases.

Experimental CWD Infection and Bioassay in the Ferret

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Based on the work of Bartz et al., we have developed the ferret model of CWD infection and employed this system to: (1) compare brain lesions and PrP^{CWD} distribution in brain and lymphoid tissues in ferrets with those in deer, and (2) assay secretions/excretions from deer for CWD prion infectivity. Groups of ferrets were inoculated via the oral or intracerebral (i.c.) route with CWD+ vs. CWD- deer brain homogenates, white blood cells, or saliva. Inoculated ferrets were monitored clinically and either sacrificed at pre-determined intervals from 3 to 24 months post inoculation (pi) or when terminal symptoms developed. Ferrets inoculated ic with CWD+ brain developed clinical neurologic disease and were euthanized between 14 and 19 months. Tissues were examined by histopathology, and by immunohistochemical staining, ELISA, and western blotting

for PrP^{CWD}. Histopathologic lesions indicative of TSE included spongiform vacuolation and neuronal necrosis. PrP^{CWD} was demonstrated in ferret brain by ELISA and western blot assays. In addition, dual immunofluorescent staining revealed PrP^{CWD} localized at astrocyte surface membranes and within neurons. Results to date from ferret bioassay of saliva and blood cells from CWD+ deer will be reported. These studies confirm the susceptibility of the ferret to CWD infection and pose the potential that CWD infectivity can be assayed in this small animal model.

SESSION V

Assessing Potential Interspecies Transmission of TSE Diseases at the Molecular Level

Gregory Raymond, USDHHS, National Institutes of Health; NIAID, Rocky Mountain Laboratories

Chronic wasting disease (CWD) is a transmissible spongiform encephalopathy (TSE) disease of cervids (deer and elk) and little is known about the transmissibility of CWD to other species. The conversion of the normal protease-sensitive host prion protein (PrP-sen) to a disease specific protease-resistant form (PrP-res) is a key biochemical event that occurs during all TSE diseases. We have developed a rapid and simple system in which PrP-sen can be converted to PrP-res in a test tube. Data from experiments using this system show that PrP-res isolated from CWD-infected cervids (PrP^{CWD}) readily induces the conversion of normal cervid PrP-sen molecules in accordance with the known transmissibility of CWD amongst cervids. In contrast, PrP^{CWD}-induced conversions of human, cattle, sheep, and rodent PrP-sen were significantly less efficient. These results demonstrate a barrier at the molecular level that could limit the transmissibility of CWD to these non-cervid species.

Experimental Cross-species Transmission of CWD at NADC

Amir N. Hamir and Janice M. Miller, National Animal Disease Center, ARS, USDA

At the National Animal Disease Center (NADC), Ames, Iowa, we have initiated studies on the experimental transmission of CWD agent to cattle, sheep, and raccoons. In all 3 experiments the inoculum used was of mule deer origin, and the route of administration was intracerebral. None of the experiments have as yet been completed. These investigations are of long-term duration; therefore, an interim progress report of the 3 studies is warranted.

The cattle experiment was started in 1997 and in 2001 we published a preliminary report documenting TSE-like disease in 3 of the 13 inoculated cattle (J Vet Diagn Invest 13:91-96, 2001). Since then 2 other inoculated cattle have been euthanized. Neither of these cattle had lesions in their brains and both were negative for PrP by immunohistochemistry (IHC). At this time, approximately 5 years post inoculation (PI), all remaining cattle are apparently healthy. The sheep experiment was initiated in 1999 with 8 animals, including 4 of each 171 genotype (QQ or QR). Since the start of this experiment, 1 QQ sheep has been euthanized and the brain of this animal was negative for PrP by IHC. At this time, approximately 3 years PI, all remaining sheep are apparently healthy.

The raccoon study was begun in 1999. In this investigation, 4 raccoon kits were inoculated. This experiment was part of a larger study to see if raccoons could be used as a model for differentiation of scrapie, TME, and CWD. At this time, 3+ years PI, all raccoons in the CWD-inoculated group are apparently healthy.

Is Chronic Wasting Disease Naturally Transmissible to Cattle?

Elizabeth S. Williams, University of Wyoming

In 1997 a collaborative and integrated study of the susceptibility of cattle to chronic wasting disease was initiated by the University of Wyoming, Colorado Division of Wildlife, Wyoming Game and Fish Department, and Agricultural Research Service. This ongoing study has examined susceptibility of cattle exposed to CWD by intracerebral inoculation, oral inoculation, and by contact with CWD affected cervids in endemic facilities. Three of 13 cattle inoculated

intracerebrally developed evidence of CWD transmission. Cattle exposed via more natural routes of exposure have shown no evidence of CWD. Based on results of comparable studies, cattle appear to be more resistant to infection by the CWD agent than to the scrapie agent.

Potential Outcomes Following Cross-species Transmission of Transmissible Spongiform Encephalopathy Agents

Richard Race, U.S. Dept. of Health and Human Services, National Institute of Health, Rocky Mountain Lab

Transmission of BSE to humans greatly increased concern among scientists and the general public regarding the potential risks of transmission of other transmissible spongiform encephalopathies (TSE), including CWD to humans. Cross-species transmission of TSE infectivity leading to clinical disease has been observed in a variety of animal species. However, what occurs in exposed animals that do not develop overt clinical disease has not been fully determined. In order to study this situation we inoculated mice with hamster scrapie agent (mice are regarded as resistant to hamster scrapie agent) and followed the pathogenesis of disease through four passages in mice and hamsters totaling over six years. By the 4th passage strains had evolved that were hamster-tropic, mouse-tropic, or dual-tropic. So even in a species thought to be resistant to infection active replication with eventual overt disease occurred. Possibly other TSE agents also have the capacity to persist and adapt over long periods of time.

Susceptibility of Transgenic Human-PrP and Transgenic Bovine-PrP Mice to Chronic Wasting Disease

Patrick Bosque and Michael Scott, University of Colorado Health Sciences Center

A major component of the "species barrier" to the transmission of prion diseases is interspecies differences in the amino-acid sequence of PrP. The species barrier to the transmission of at least some strains of human, bovine, hamster and murine forms of prion disease to mice is abrogated in transgenic mice that produce only PrP with the amino-acid sequence of the appropriate species. These observations suggest that such transgenic mice might mimic the susceptibility of the cogent species to prion diseases of other species. In order to model human and bovine susceptibility to CWD, we inoculated transgenic mice, expressing either human PrP (codon 129M) or bovine PrP, with brain homogenates from elk, mule deer and white-tailed deer with histopathologically and biochemically confirmed CWD. In both mouse lines, the transgenes were expressed on an FVB background from which the native murine PrP gene had been disrupted. After post-inoculation intervals ranging from 500 to >650 days, no mice have developed a neurologic disorder typical of prion disease. These results are encouraging, but some evidence suggests these transgenic mice may imperfectly model the interspecies transmission of prion diseases.

Molecular Epidemiology of Cruetzfeldt-Jakob Disease in the U.S.

Shu G. Chen, Case Western Reserve University and National Prion Disease Pathology Surveillance Center, Cleveland, OH 44106

In response to an increasing threat to public health by prion diseases, the National Prion Disease Pathology Surveillance center was established at Case Western Reserve University in 1997. The purpose of the Center is to collect, characterize, and store all cases of suspected and proven prion disease in the U.S. This is done in order to timely detect U.S. cases of variant Creutzfeldt-Jakob disease (vCJD) and other cases due to exogenous infection and to monitor all cases of prion disease to limit possible sources of infection. As of March 31, 2002, a total of 787 cases have been examined; 576 of these cases had a prion disease, which was classified as sporadic in 423 cases, familial in 50 cases and iatrogenic in 3 cases. No case of vCJD was detected. Neuropathological examination and prion protein typing have been performed on all positive cases. Most recently, we have also characterized prion proteins in affected deer and elk with chronic wasting disease using Western blotting and protein microsequencing.

Is Chronic Wasting Disease Transmissible to Humans?

Ermias Belay, Center for Disease Control

The transmission of bovine spongiform encephalopathy to humans causing variant Creutzfeldt-Jakob disease (CJD) in Europe has created a concern about the possible zoonotic transmission of other animal transmissible spongiform encephalopathies prevalent in the United States such as chronic wasting disease (CWD) of deer and elk. This concern was heightened by the recent detection of CWD in free-ranging deer outside of the known CWD-endemic areas and the occurrence of unusually young CJD patients who were reported to have regularly consumed venison. However, investigation of these unusually young CJD patients found no strong evidence for a causal link between CWD and the CJD illness in the patients. Ongoing CJD surveillance as well as epidemiologic and laboratory investigations remain critical for continuing to assess the risk, if any, of CWD transmission to humans.

Occurrence of Creutzfeldt-Jakob Disease in Colorado and Wyoming

John Pape, Colorado Department of Public Health and Environment

Surveillance for human transmissible spongiform encephalopathies was initiated in Colorado in 1997 when the Colorado Board of Health made human TSE, in persons less than fifty-five years of age, a reportable condition. The age parameter was removed in 2000. In the four years with complete data (1998-2001), eighteen cases of human TSE in Colorado residents were reported. Three additional cases, including a case of GSS, were identified in residents from other states (NE, KS, NC). Ten patients were female. Mean age was 64.8 years (range 40–79). One patient, a 61 year-old woman, was determined to have a history of venison consumption from Colorado's CWD endemic area. Pathological examination was consistent with sporadic CJD.

SESSION VI

Public Hunter Perspectives on Hunting in CWD Areas: Should Hunters be Concerned?

Gary J. Wolfe, Chronic Wasting Disease Alliance, Missoula, MT

With the growing media attention given to Chronic Wasting Disease, many hunters are asking if they should continue to hunt in areas where CWD has been identified, and to eat the deer and elk they harvest from those areas.

In areas where CWD occurs, only a relatively small number of animals are infected. Even in the parts of Wyoming and Colorado where chronic wasting disease has existed for at least 30 years, an average of less than six percent of deer are infected. CWD is far less prevalent in elk than deer. Less than 1 percent of elk found in areas where the disease occurs in northeastern Colorado are infected.

There is currently no scientific evidence that CWD can spread to humans, either through contact with infected animals or by eating meat of infected animals. The Center of Disease Control has thoroughly investigated any connection between CWD and the human forms of TSEs and stated: "Although it is generally prudent to avoid consuming food derived from any animal with evidence of a TSE, to date, there is no evidence that CWD has been transmitted or can be transmitted to humans under natural conditions. However, there is not yet strong evidence that such transmissions could not occur."

Hunters should take the following commonsense precautions when field dressing and processing deer or elk taken in areas where CWD is found:

- Do not shoot, handle or consume any animal that is acting abnormally or appears to be sick.
- Wear latex or rubber gloves when field dressing deer or elk.
- Bone out the meat. Don't saw through bone, and avoid cutting through the brain or spinal cord (backbone).
- Minimize the handling of brain and spinal tissues.

- Wash hands and instruments thoroughly after field dressing is completed.
- Avoid consuming brain, spinal cord, eyes, spleen, tonsils and lymph nodes of harvested animals.
- Avoid consuming the meat from any animal that tests positive for the disease.
- If the deer or elk is commercially processed, it should be processed individually, without meat from other animals being mixed together.

State and provincial wildlife agencies are stepping up their surveillance for CWD, so be alert to their advisories and follow the recommended safety precautions. Concerns over CWD shouldn't stop you from enjoying this hunting season.

Why Hunters Should Not Be Required to Consume Deer or Elk Harvested in CWD Endemic Areas

Dick Steele, Western Colorado Sportsmen's Council

1. This is not an individual health issue. The chances of a hunter contracting CJD from his deer or elk after testing negative for CWD and handling the meat properly is remote.
2. This is a human health threat with very serious potential consequences. Unlike BSE, CWD is spread by animal-to-animal contact. This is by ingestion or inhalation of saliva, feces, or possibly urine. Excreta of one animal comes in contact with tonsils or the intestinal tract of another animal. This is how many human diseases are transmitted such as the common cold and salmonella. With BSE it was consuming infected tissues. This is easy to circumvent by not eating infected material.
3. If the CWD prion adapted to just one human it could potentially instigate an epidemic. The really threatening aspect is we would not know it existed until it had spread among the population for ten or more years when the first person exhibited clinical symptoms. Therefore we need to consider protecting the entire human population not just the individual hunters safety.
4. Locker plant amplification of exposure is likely since the prion is not inactivated by currently used cleaning methods of hot water. One pound of sheep brain infected with scrapie contains 454 million infective doses of prion. Very minute amounts of lymph node tissue from a CWD deer could contaminate an entire locker plant and every carcass that passes through it subsequently.
5. Field dressing situations are very difficult to control. First the hunter is often tired from a long hunt. Or he may be charged with adrenaline. It is easy to cut into spleen or mesenteric lymph nodes in gutting the carcass. If several people are involved, one person may be cutting the horns off exposing the brain tissue while others are cutting up the meat. It is easy to share knives and saws in the process. If the person removing the skullcap and horns completes his task first he may assist the others bagging up the meat or even cutting up the meat.
6. CWD prions are much closer in structure to scrapie prions than are BSE prions to scrapie prions. Ergo if BSE came from scrapie, CWD is more likely to have originated from scrapie prions. According to Paul Brown of the National Institutes of Health and others, once prions cross the species barrier they are more likely to adapt to other species. This is what we saw with BSE transmitting from scrapie to cattle to a multitude of other species. Raymond et al. showed that in vitro human prions were converted by CWD prions at approximately the same efficiency as they were converted by BSE prions (7% versus 10%). This should ring in a serious warning that cross species transmission is possible.
7. Human exposure to CWD has been so limited that statistically we are unlikely to have seen one single case at this time. Comparing harvest data to CWD prevalence rates would indicate that fewer than 300 CWD infected elk and fewer than 3000 CWD infected deer have been harvested from Colorado's endemic area in the last 30 years. If each hunter shared his game meat with 10 people we would have a maximum of 33,000 people exposed to CWD. At this point in time 120 people have died in Britain of nvCJD out of 60 million people exposed. This equates to one case per 500,000 people exposed. We are 467,000 exposures to CWD short of having enough to develop one case. To say there is no evidence that CWD cannot transmit to people is quite premature.

8. CWD has been transmitted to a primate by intracerebral injection (squirrel monkey). Another warning shot across our bow that should not be ignored as it was with BSE.
9. The finding of scrapie prions in the hind leg muscles of scrapie infected mice indicates we need to look for the CWD prion in different muscle groups of deer and elk. If found, human exposure may be possible with meat consumption.

Policies and Strategies for Managing Chronic Wasting Disease in Colorado

Rick Kahn, Colorado Division of Wildlife, 317 West Prospect St. Fort Collins, Co. 80526

In September 2001 the Colorado Wildlife Commission adopted a comprehensive policy that gives direction to the Division of Wildlife (DOW) for managing Chronic Wasting Disease (CWD). The policy details three types of zones within the state that have differing management goals. They include:

- » Class III CWD Discovery area – those areas where a documented case had been found but the extent of the infection is not known. The goal is to eradicate the disease in these areas.
- » Class II CWD Elimination area – those areas where CWD exists in wild populations and where there is a reasonable possibility of eliminating the disease.
- » Class I CWD Established area (Endemic) – those areas where CWD is endemic and where there is no reasonable opportunity for elimination.

The overarching goals include preventing the spread of the disease to areas where it is not known to be found, reduce the prevalence in the Class I areas and to eliminate the disease in the Class II and III areas. The policy directs the DOW to establish new Data Analysis (herd) plans within the Class I areas that call for a reduction in prevalence rates to 1% by DAU and 2% or less by Game Management Unit. These plans also emphasize CWD management rather than herd viability or recreation. The policy continues the role of public hunting as one tool to manage the disease. Hunters will be given the best scientific information available and be encouraged to make an informed decision on whether they desire to hunt in CWD areas. In addition, the policy outlines the continued role of increased research, directs the DOW to develop statewide surveillance plans and increase communication between the DOW and hunters, the state and federal Departments of Agriculture and other state wildlife agencies.

The DOW has a multi-faceted approach to managing CWD. In addition to continuing surveillance activities and increased research into transmission routes and environmental persistence the DOW has outlined the following as management strategies:

1. Targeted culling – via either hunter harvest surveillance or targeted surveillance the DOW has adopted a strategy of identifying and killing small (generally <30) distinct groups of deer and elk where CWD has been found. In Class II and III areas the DOW is targeting larger numbers of deer and elk on a wider geographic scale.
2. Experimental deer density reduction (GMU 9) – DOW is attempting to reduce the deer populations by 50% in a 3-year period and hold it there for 5 years to determine the effects on CWD prevalence.
3. Experimental “test and slaughter” – In areas where culling is not feasible and where partners are helping to fund the experiment, the DOW is capturing deer, taking a biopsy of the tonsil, marking the animal and then running diagnostic tests. If an animal is found to be positive the animal is relocated using radio telemetry and then killed.
4. General Population management – in order to reduce or hold populations in the endemic area and reduce seasonal deer and elk movements the DOW has increased hunting licenses, offered either-sex licenses, allowed >1 carcass-tag per license, and increased opportunities for private landowners to take deer and in some cases elk on land they control.
5. Movement studies – DOW staff are increasing the number of deer and elk with radio collars in the endemic area to determine if individuals or small groups of animals are making movements outside the endemic area. If movements are noted the animals making the movements are killed.

Policies and Strategies for Managing Chronic Wasting Disease in Wyoming

Tom Thorne, Wyoming Game and Fish Department

In Wyoming, chronic wasting disease (CWD) was first diagnosed in a captive deer at the Sybille Wildlife Research and Conservation Education Unit in 1978 and in a free-ranging elk in southeast Wyoming in 1986; however, it is likely the disease was present, but unrecognized, in free-ranging and captive cervids much earlier. Management of CWD started in 1983 with random and targeted surveillance for CWD through cooperative efforts of the University of Wyoming and Wyoming Game and Fish Department. Since then the Department has participated in a collaborative manner in many intra- and interstate CWD activities, including surveillance, research, restriction on transport of exposed cervids, removal of suspect affected animals, information and education efforts, and communication. Chronic wasting disease was identified as a priority topic for research by the Wyoming Wildlife/Livestock Disease Research Partnership, which was established by the Wyoming Legislature in 2001.

In 2001 CWD was elevated in significance by the Department when a previously existing internal CWD committee was restructured and Deputy Director Gregg Arthur assumed the role of chairman. That committee reviewed the Department's CWD activities and is drafting a "Wyoming Game and Fish Department Chronic Wasting Disease Management Plan," which will be presented to the Wyoming Game and Fish Commission in September 2002.

The Wyoming Game and Fish Department and Commission regard CWD as a high priority issue facing Wyoming. The Department assisted in drafting the national "Plan for Assisting States, Federal Agencies, and Tribes in Managing Chronic Wasting Disease in Wild and Captive Cervids" and generally supports the current draft.

Wyoming estimates it will need approximately \$ 1,970,760 in FY 2003 and \$ 2,163,360 in FY 2004 in new money to participate fully in state, regional, and national CWD plans and research (\$825,000 is a duplicate budget request in each budget for double funding the Sybille facility. If funded in FY03, it will not be needed in FY04).

Policies and Strategies for Managing Chronic Wasting Disease in Nebraska

Bruce Morrison, Nebraska Game and Parks Commission, 2200 N. 33rd Street, Lincoln, NE 68503

The Nebraska Game and Parks Commission (NGPC) has adopted several strategies for managing CWD in free-ranging cervids in our state. The aim of these actions are two fold: 1) minimize the potential for the spread of CWD beyond the area where it currently occurs and 2) reduce the level of incidence within the infected area with the goal of eradication from the state. Management actions include the reduction of cervid populations in endemic areas by either innovative hunting seasons or agency sharpshooters, working with the Nebraska Department of Agriculture to monitor captive cervid facilities, supporting research into CWD, providing public information and developing long range management plans for free-ranging herds with CWD.

Although there is not an official policy, unofficial policy that guides our decision making includes:

1. It shall be the policy of the NGPC to support, on a priority basis, research that will facilitate the continued expansion of knowledge of CWD.
2. It shall be the policy of the NGPC that hunting opportunity in the area where CWD is known to exist, or areas where it may be found in the future, will continue to be available to assist in the management of deer and elk herds to reduce and/or eliminate the prevalence of CWD. In the endemic area, however, it shall be the policy of the NGPC that conflicts between disease management and recreational hunting opportunity shall be resolved in favor of disease management.
3. To the extent that it is practical, it shall be policy that all cervids killed by Commission personnel in Nebraska for research and/or management purposes be tested for CWD. In addition, the Wildlife Division is directed to work cooperatively with the public to provide for testing of hunter harvested animals in the endemic area to the extent necessary to determine prevalence and range of CWD in Nebraska.

4. Information that is accurate, current and understandable by the general public will be made available to the public to enable all interested parties to make informed decisions about CWD and its impacts on their recreation planning. Dissemination of information will be through hunt guides, traditional media press releases, internet postings, direct mail and other appropriate information outlets.
5. The translocation of cervid species for the purposes of reestablishing and/or augmenting populations will not be conducted in Nebraska until such time as CWD is eliminated from the state and/or a live test is available.

Policies and Strategies for Managing Chronic Wasting Disease in Saskatchewan

Kevin Omoth, Saskatchewan Ministry of Environment

Policies and Strategies for Managing Chronic Wasting Disease

Ron Fowler, South Dakota Department of Game, Fish and Parks

South Dakota, as a result of surveillance involving hunter-harvested deer and elk, had its first case of chronic wasting disease (CWD) in free-ranging deer in the Fall of 2001. Until that time (since 1997) the policy and strategy for addressing potential for CWD in free-roaming deer was to conduct general surveillance across the state, with some emphasis in deer and elk management units that had previously contained captive cervids testing positive for CWD. As a result of the detection of the positive CWD deer, and the coincidental finding of CWD by Nebraska investigators in free-ranging cervids in Nebraska within 15 miles of the South Dakota county where the CWD deer was located, policies and strategies were changed in early 2002.

One change was to collect additional deer, outside of hunting seasons, in order to ensure a sample size that would provide the necessary confidence in detecting additional CWD cervids if present and, if so, determination of prevalence rate. A second change was to shift the deer population management goal in units adjacent to Nebraska CWD units, and also the unit that had the CWD deer, from a goal of maximizing the deer population within landowner tolerance limits, to a goal of reducing deer density. A third change was increased emphasis on collection and testing of target cervids (cervids with abnormal appearance and/or behavior) across the state. A fourth was increased emphasis on providing more factual CWD information to the public in a larger variety of forums.

Policies and Strategies for Chronic Wasting Disease in Wisconsin

Tom Hauge, Wisconsin Department of Natural Resources

The State of Wisconsin received test results confirming the detection of Chronic wasting disease (CWD) in 3 free-ranging Wisconsin white-tailed deer on February 28, 2002. In the 5 months since this information became known, Wisconsin has faced a long and challenging list of actions and issues requiring a state response. CWD management requires close coordination between all state agencies with responsibility for human health issues, research, meat safety, captive cervid and animal agriculture, as well as, free ranging cervids. Communication and public involvement is a constant and critical challenge in CWD management. Most states, if not all, will need financial and technical assistance from Federal agencies to successfully address CWD management. State agencies must also assess whether or not they have the needed legal authority to deal with critical aspects of the disease

A Border State Perspective on CWD Management

Lloyd B. Fox, Big Game Program Coordinator, KDWP, P.O. Box 1525, Emporia, KS 66801

The Kansas Department of Wildlife and Parks (KDWP) considers chronic wasting disease (CWD) a significant threat to wildlife management. The nature of that threat includes not only the biological effects of the disease on the ecology of deer and elk, but also the threat upon the

fundamental concepts of public agency management of wildlife. Public enthusiasm for deer and elk has historically shaped natural resource management in North America. Hunter-based funding for conservation is hinged on the values hunters associate with these species.

Kansas is one of thirteen states that border a state where CWD has been confirmed. While the number of cases so far and the distance between the nearest positive animal and our border may give some a sense of security, no barriers guarantee this disease will remain stationary in its current distribution. With interstate translocation of live animals (primarily in the alternative livestock industry), long distance dispersal of wild cervids, and the unregulated movements of carcasses and products, there is potential for the disease to enter Kansas from many directions.

The waters for CWD control are muddy. Many agencies, organizations and individuals have jurisdiction and special interests that influence potential control programs for CWD. We have not established formalized agreements in Kansas among these entities, however, a cooperative atmosphere has developed. Personnel from USDA, Kansas Animal Health Department and KDWP have worked and trained together. Communications between the public wildlife agency and private elk breeders occur although no regulatory oversight exists. KDWP is exploring multi-state management plans with our neighbor states. Traditional single state single agency efforts will undoubtedly be inadequate. Multi-state and multi-agency cooperation in monitoring, enforcement and research may tip the odds toward success.

CWD monitoring with targeted surveillance has been in place since 1996. Random testing on hunter harvested animals began in 1997. It had been focused in western Kansas until USDA detected a positive elk in a privately owned herd in south central Kansas in November 2001. We have conducted tests for CWD on 1,167 deer and elk since 1996 with no positive animals detected in the wild. Future monitoring efforts will include statewide random surveillance (we plan to sample 1,200 animals during the 2002 season) plus statewide targeted surveillance. Preemptive population management has also been initiated. We have managed deer populations in the northwest portion of the state with an objective to lower population densities. One goal of that program is to reduce the potential for CWD establishment. We also believe that a lower deer density could be beneficial in disease control if CWD were to establish. This approach is not popular with deer hunters and has been questioned by agency personnel. KDWP plans to implement an early aggressive intervention if CWD is detected. Hunters and landowners will be encouraged to participate in disease eradication efforts. Control efforts will be focused at the level of deer social groups around sites where a CWD positive animal is detected.

Accounting for safety and economic issues will be crucial to maintain credibility and public confidence. Fear is not a factor that makes the CWD management message urgent and memorable. Practical and personal information may get the CWD management message incorporated into action programs.

Chronic Wasting Disease (CWD) in Alberta: Policies, Programs, Strategies

M.J. Pybus, Fish and Wildlife Division, 6909-116 Street, Edmonton, Alberta T6H 4P2

Alberta has a background of limited exposure risk to CWD (<1200 imported game farm elk, no imported deer) and relatively low transmission potential for maintaining the disease in wild populations (deer and elk density generally less than 5 per sq. mi.). Hunter surveillance data since 1998 indicate CWD does not exist as a general infection in wild populations at detectable levels (99% confidence of detecting disease at 0.2% prevalence). As a result, Alberta has adopted a policy of prevention/eradication of CWD. Guiding principles to the program include science-based decisions following cooperation and consultation among various provincial and federal agencies as well as input from US colleagues. Primary program tools include voluntary hunter surveillance, landowner permits, emergency response collections, game farm surveillance, and the federal reportable disease program, in addition to strict import restrictions and a prohibition on baiting ungulates. Areas of direct concern are the shared border with Saskatchewan and the immediate vicinity of any CWD positive farm (one farm to date). Enhanced surveillance is conducted in these areas for at least three years. **IF** CWD is found in wild ungulates in Alberta, eradication efforts will be implemented.

Managing Chronic Wasting Disease in Free-Ranging Cervids: Policies and Strategies for Managing CWD

Steve Williams, *Director*, U.S. Fish and Wildlife Service, 1849 C Street, NW, Washington, DC 20240

The Department of the Interior recognizes that States have the primary responsibility to carry out wildlife management to control Chronic Wasting Disease (CWD). Our policies and strategies support this recognition and we will continue to work closely with the states in managing and controlling outbreaks of CWD on lands managed by the Department. For example, the Fish and Wildlife Service and Colorado Division of Wildlife (CDOW) recently agreed to jointly address CWD if, and when, an outbreak occurs on National Wildlife Refuge lands. This agreement will include survey, testing, and active management, including necessary efforts to depopulate infected herds. The National Park Service is cooperating and coordinating with the states regarding prevention, surveillance, research, and control actions for CWD. Examples include an agreement between Rocky Mountain National Park and CDOW and the ongoing cooperation between the Grand Teton National Park and Wyoming Game and Fish Department. The Bureau of Land Management (BLM) continues to work very closely with the States and their policy requires that State BLM Office's develop and maintain up-to-date MOUs with the appropriate State wildlife management agencies. The Bureau of Indian Affairs does not have rules, regulations, or policies for controlling or managing CWD on Tribal lands, since tribal lands are sovereign. Nevertheless, many Tribes and intertribal fish and wildlife organizations will no doubt want to join with Federal and State efforts in monitoring and controlling CWD. Although not a land management bureau, the U.S. Geological Survey will play an important role in assisting the states by providing research, information, and technical assistance that will contribute to the effective management of this disease. Finally, the Department will need to consider how to use NEPA to inform the public about approaches dealing with CWD. The Department will immediately begin fleshing out the need for NEPA compliance for cases including the use of federal funding by the states and for proposed large scale management actions.

Options and Considerations for the Disposal of Carcasses from CWD-infected Cervid Populations in Wisconsin

Doris Olander and Joe Brusca, Wisconsin Department of Natural Resources

Chronic wasting disease (CWD) is an invariably fatal neurologic disease of deer and elk. The management of CWD, whether it is present in captive or free-ranging populations, requires specific plans to dispose of the carcasses generated by disease control activities. In Wisconsin, the Department of Natural Resources disease management plan for CWD calls for the depopulation of approximately 15,000-25,000 white-tailed deer in 2002 alone. Citizen-hunters will kill the majority of these animals. Based on previous surveillance data an estimated 3% of the targeted population will be CWD-infected. It is anticipated that the majority of the hunters in the CWD eradication zone will not retain the carcasses for home consumption. Therefore, a mechanism for the disposal of these carcasses is needed. The challenges that must be addressed in designing a disposal program include the unique physical and biological properties of the CWD agent, incomplete knowledge of the specific mechanisms of CWD transmission, and the lack of a rapid diagnostic test or a practical analytical method for sampling air, water or soil for the infective agent. Further complicating factors include the high level of public interest and concern and the necessity for coordination and cooperation between multiple local, state, and federal agencies.

CWD is a member of the transmissible spongiform encephalopathies (TSEs) that include scrapie of sheep, bovine spongiform encephalopathy (BSE) of cattle and Creutzfeldt-Jakob Disease of humans. The transmission of BSE to humans and the uncertainty regarding the transmissibility of CWD to humans requires the consideration of CWD as a possible zoonotic agent. In addition, the causal agents of the TSEs are collectively recognized to have the potential for extended survival in the environment and to be resistant to many, but not all, processes that are traditionally used for the inactivation of conventional microorganisms. Five options for the disposal of carcasses from CWD-infected populations have been considered in Wisconsin. These

are: landfilling in a modern engineered site, burial at an uncontrolled site, dedicated rendering with controlled disposal, incineration and “digestion” (high-temperature, high-pressure alkaline hydrolysis). Each of these options has advantages and disadvantages for given applications with no option providing a zero risk, but all providing a low risk alternative. Landfilling and burial of carcasses have excellent capacity and lower cost, but offer no or very low inactivation of the agent and raise concerns regarding environmental contamination in uncontrolled sites. Dedicated rendering with controlled disposal offers some level of agent inactivation (depending on the disposal process utilized) and is currently used for populations of cattle at higher risk for BSE in Europe. To date, it has never been utilized in North America. Incineration, of which there are a number of methods, offers the potential for complete inactivation if sufficiently high temperatures are achieved. With the exception of air curtain destructors (ACDs), incinerators have low capacity and are costly. ACDs are a less controlled means of incineration. They generally have high capacity and can achieve and maintain (with fluctuations) temperatures in excess of 600° C , but require excellent operator skills to maintain throughput, high temperatures and keep smoke to a minimum. The “digestion” of carcasses in the presence of high pH, temperature and pressure offers excellent inactivation, but has low throughput capacity. In addition, the resulting liquid requires specialized handling because of its high biological oxygen demand and pH.

Wisconsin has a number of local and state regulatory and zoning requirements, some of which may be unique. They provide for considerable public input and additional regulatory requirements for virtually all disposal options considered. Given the regulatory climate and the geology of the region of the CWD epizootic, burial of deer carcasses in uncontrolled sites has been eliminated as an option. At present, landfilling, incineration, digestion and dedicated rendering remain viable options for disposal and are being evaluated for feasibility, safety, cost and community acceptance.

There is, in summary, no single best answer for the disposal of CWD-infected populations nor is there any “zero-risk” option. All of these disposal methods elicit public concern about public, animal and environmental health. For burial, landfills, rendering and digestion, concerns about water contamination and quality are frequently raised. For incineration, the concern is generally focused on airborne dispersal of the agent. The number of animals to be disposed of, local conditions, state and local regulations and available resources will guide specific disposal options selected. Regardless of the disposal method(s) selected, considerable outreach to the general public, other regulatory agencies and even within the “home” agency will be needed.

Review of Chronic Wasting Disease Programs in Colorado

Gary Wobeser, Michael D. Samuel, Markus J. Peterson, Victor F. Nettles, and Will Hueston
USGS National Wildlife Health Center

Chronic Wasting Disease (CWD) has been recognized in free-ranging cervids in Colorado since 1981. More is currently known about the distribution and ecology of the disease in Colorado than in any other area of North America. In May 2002 an independent panel of scientists reviewed the Colorado Division of Wildlife (CDOW) management program on CWD. The panel believes that CDOW should be commended for their scientific and management leadership in investigating this disease. CDOW staff are recognized among the leading experts in research and management of this disease in free-ranging cervids, and CDOW programs on CWD serve as models for other wildlife management agencies. Because there is little scientific knowledge about many ecological aspects of the disease, management policies and programs should be considered as experimental and adaptive. The panel recognizes the significance of the policies and management programs established by the CDOW to manage CWD. The panel recommends an additional policy objective of eliminating CWD, when found outside the endemic areas, and the enhancement of specific management plans for controlling the disease. The panel recommends that management of CWD should integrate research, management, and surveillance plans to enhance the capability to control this disease. The panel also recommends several enhancements to the CDOW research and management programs designed to increase scientific knowledge about the disease and to improve the success of future management actions.

Cervid Behaviour, Ecology and Policy Considerations Aimed at Eliminating CWD from Free-living Cervid Populations

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Potential avenues of intra- and inter-specific transmission of Chronic Wasting Disease (CWD) are discussed in relation to the social behavior and ecology of free-living mule deer, white-tailed deer, and elk. Deficits in research are identified, as well as applications to contain or eliminate CWD from the wilds. Some of these have manpower, organizational, and financial requirements that only North America's organized sportsmen can provide. Their active involvement is essential as is the spelling out of tasks to be fulfilled.

Origins of CWD and Management Policy

Charles H. Southwick, University of Colorado

Among essential research needs on CWD highlighted by this conference, there is a critical gap in understanding the origins of CWD. Historical records of North American deer populations show patterns of die-offs since the Civil War. Some die-offs have been obviously due to starvation, but many have been attributed by veterinarians to disease. Morbidity symptoms were described in the older scientific literature as ..."lacking alertness...lethargic...emaciated...

...staggering...erratic actions...muscular incoordination...slobbering...and ...wasted..." These are all primary symptoms of CWD, but prior to the 1960's no one considered brain stem histology. If CWD, or related prion infections were involved, this knowledge would completely change our management policies and control efforts. Modern research on molecular barriers to prion disease has shown that conversions of PrP-CWD to ovine PrP-sen prions can occur with intermediate frequency, meaning that conversion of scrapie to CWD or vice-versa is possible. Since Old World domestic sheep were introduced to the New World as early as 1519 by Spanish Conquistadors, scrapie to CWD conversions have had over 400 years to occur in either natural or captive conditions.

Public Perspectives on Chronic Wasting Disease

Glen Zebarth, North American Elk Breeders Association

Concerns of Whitetail Hunters and Managers Regarding CWD

Brian P. Murphy, Quality Deer Management Association

White-tailed deer (*Odocoileus virginianus*) are the most popular and economically important big game animal in the U.S. In 2001, an estimated 10.9 million big game hunters spent over 153 million days afield and contributed nearly \$20 billion to the U.S. economy. The discovery of chronic wasting disease (CWD) in free-ranging white-tailed deer in Wisconsin has raised numerous concerns among whitetail hunters and managers. Hunter attitudes range from highly concerned to unaware. Most are confused and seeking information from all available sources.

Unfortunately, to date, most information has come from the popular media, which has further confused and inflamed the situation. Whitetail managers are concerned about the potential biological, social, and economic impacts of CWD. All agree that additional monitoring and research is necessary, but many are more concerned with the potential impacts on their ability to manage burgeoning herds and on the future of the deer-hunting heritage. They feel that fears of CWD could lead to reductions in deer hunter numbers and resistance to harvesting adequate numbers of female deer. Both would make it more difficult to achieve desired deer harvest goals and maintain acceptable population densities. I contend that a nationwide educational campaign involving state and federal agencies, conservation organizations, and the hunting media is necessary to address hunter concerns and solicit their cooperation and support for ongoing deer management and CWD efforts. I further contend that a non-governmental organization, such as

the Chronic Wasting Disease Alliance (comprised of major national conservation organizations), would be the appropriate conduit for this educational campaign and would achieve the widest acceptance by the hunting public.

Chronic Wasting Disease and the North American Model of Wildlife Management

Stephen C. Torbit, National Wildlife Federation, 2260 Baseline Road, Suite 100, Boulder, Colorado 80302

Traditional wildlife management strategies can be constrained by the presence of diseases in wildlife populations. The presence of Chronic Wasting Disease (CWD) has justifiably generated significant concern regarding health of wild deer (*Odocoileus spp.*) and elk (*Cervus elaphus canadensis*) populations. The presence of CWD in wild cervid populations will create unprecedented challenges to wildlife managers as they scramble to reduce prevalence of CWD, maintain public support for wild cervids by disseminating public health information and hunting guidelines and conducting research into transmission and causative agents. However, little attention is being paid to the potential impacts of CWD and other diseases on the management authorities of state and federal wildlife agencies, the ability of wildlife to access public lands or the precedential consequences of management actions and proposals. Serious erosion of state and federal wildlife authorities has already occurred because of the presence of brucellosis exposed bison (*Bison bison bison*) in Yellowstone National Park. The passage of the Animal Health Protection Act (AHPA) in 2002 has ominous implications for wildlife and the North American model of wildlife management by placing authority over all diseased animals in the USDA. The presence of CWD on the landscape will only escalate the vulnerability of wildlife to agricultural domination. Management decisions made by wildlife agencies to address CWD issues must be made in the context of maintaining their authority over wildlife and must not set a precedent for agricultural disease management. Twenty-first century wildlife managers must not shrink from the policy gauntlet that lies ahead, as have some of their predecessors. Management outcomes for CWD and other wildlife diseases can invigorate or undermine our fundamental concepts of wildlife and the successful wildlife management system developed to manage wildlife resources in North America. A rigorous and lengthy public debate must occur now to determine how wildlife resources and public lands will be managed in the future. By reviewing current information regarding these resource policy issues, I encourage natural resource professionals to confront these challenges and begin the professional discussion necessary to maintain wildlife populations and the North American model of wildlife management.

Public Perspectives on Chronic Wasting Disease: Remarks for Panel

Jack Ward Thomas, Boone and Crockett Professor of Wildlife Conservation, University of Montana, Missoula, Montana

Chronic Wasting Disease is emerging as a national issue requiring a well-coordinated national response. It has taken far too long to come to that conclusion. Too much of this delay can be traced to various responsible entities either down playing the issue for economic and political reasons including protection of “turf.” This is changing. Obviously there should be an acceleration of these efforts to assure that such a response is in-place and appropriately funded.

Clearly, appropriately qualified professionals should take the lead in these efforts. However, citizens groups with interest in CWD – such as the CWD Alliance founded by the Boone and Crockett Club, the Rocky Mountain Elk Foundation, and the Mule Deer Foundation – have responsibility to assure that improved, coordinated, and appropriately funded actions take place. These groups should serve as both goad to responsible agencies and facilitators of required activities to assure that the required funding for such actions is in place in a timely fashion.

Accurate, timely, readily available information on CWD is critical to obtaining and sustaining support for research and management action. Media coverage is now sketchy at best and often misleading at worst. The media must have access to accurate information and well-informed and qualified experts on CWD if they are to contribute fully to public understanding. The Boone and

Crockett Club initiated and maintains, now in cooperation with the CWD Alliance, a web site where all available printed information on CWD can be accessed. That web site includes a list of experts on CWD with appropriate information on how these persons can be reached so that responsible media personnel can access both information and experts. That is but one example of what conservation organizations – particularly when organized – can do to help. We stand ready to do even more.

We trust that this conference will contribute to focusing both the debate and management response to what may be the most critical issue in wildlife management to emerge in the last half century. Conservation organizations stand ready to do even more.

Chronic Wasting Disease – What the Future Holds

Len Carpenter, Wildlife Management Institute