REPORT OF THE COMMITTEE ON WILDLIFE DISEASES

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The Committee met on October 13, 2009 at the Town and Country Hotel, San Diego, Calif., from 8 AM to 12 noon. There were 36 members and 32 guests present.

USAHA Joint Working Group Committee of Wildlife Diseases and Committee on Sheep and Goats Recommendations on best management practices for domestic sheep grazing on public land ranges shared with bighorn sheep

Walt Cook, Wyoming Livestock Board

In October 2007, the United States Animal Health Association (USAHA) Committees on Wildlife Diseases and Sheep and Goats established a working group comprised of staff or members of state and federal animal health agencies, wildlife and public land management agencies, the American Sheep Industry and Wild Sheep Foundation (formerly Foundation for North American Wild Sheep (FNAWS)). The working group was charged with developing best management practices for grazing domestic sheep (and goats) on public lands where contact between domestic sheep and bighorn sheep may occur. This working group concept was subsequently endorsed by USAHA as part of a broader resolution on "Cooperative Research and Management of Wildlife/Livestock Disease Interactions" approved in October 2007. The task of this subcommittee was limited to one specific aspect of domestic sheep management, the interaction of bighorn sheep and domestic sheep on public lands. Consistent with USAHA direction, this document primarily focuses on the domestic sheep portion of best management practices in these situations. A comprehensive list of best management practices for bighorn sheep can be found in the Western Association of Fish and Wildlife Agencies (WAFWA) Bighorn Sheep Working Group Recommendations for Domestic Sheep and Goat Management in Wild Sheep Habitat (1).

Although public lands grazing is a privilege and agencies are not required to offer alternative allotments for domestic sheep grazing, work group members recognize the historical role that public land grazing has played in sustaining viable working landscapes and rural communities, and that domestic sheep and goats, as well as bighorn sheep, are important to the cultural and ecological heritage of most western states. The work group also recognizes that domestic livestock grazing can be a useful tool for habitat management. The working group, co-chaired by Drs. Walt Cook and Michael Miller, assembled relevant background information and met via multiple teleconferences, email and in person at the 2008 USAHA meeting to develop and discuss recommended best management practices. As per the group's

charge, the recommendations that were developed focus on practices intended to minimize opportunities for interspecies contact on shared range that could lead to transmission of respiratory pathogens. In some recent pneumonia epidemics in bighorn sheep, the cause has been attributed to endemic respiratory pathogens, and in other epidemics the cause has been attributed to pathogens introduced via interactions with domestic sheep (2). These recommendations do not presume to estimate the probability or risk of contact. Quantifying the risk of interspecies disease transmission between bighorn sheep and domestic sheep in a natural setting is problematic (2). Further research is needed to better understand and estimate the magnitude of potential risk to bighorn sheep arising from interactions with domestic sheep and other wild ruminant species, as well as the risks of endemic disease and potential influences of seasonal and environmental factors on these risks. Indeed, the original USAHA resolution that led to this working group directed federal agencies to fund research on epidemiology and pathogenesis of bighorn/domestic sheep disease interactions.

The report attached at the conclusion of this Committee report presents the recommended best management practices intended to serve as one element of more comprehensive approaches for managing the health of bighorn sheep populations. We recognize that all of the management practices listed may not be incorporated into some management plans, but offer them as a complete list for consideration. Hopefully these recommendations will complement or emphasize risk reduction practices already in place, and encourage their development elsewhere. Although national in scope, these recommendations do not mandate programs at the state, local, or tribal level. Local primacy dictates that management occurs at the state or regional level whenever possible. The work group members believe that these recommended best management practices represent a viable alternative to terminating domestic sheep grazing on public lands where goals include minimizing the risk of epidemics in bighorn sheep that may result from interspecies contact. However, there are cases where these practices have been considered and mutually judged to be infeasible by responsible agencies and permittees or their representatives in the course of negotiations via established processes for timely conflict resolution. When this occurs, the work group members encourage timely identification of alternative grazing allotments or arrangements to minimize impacts on permittees and interruption of ongoing domestic sheep operations.

Bovine Tuberculosis in Minnesota

Bill Hartmann, Minnesota Board of Animal Health

Minnesota was free of bovine tuberculosis (TB) for thirty years until a beef cattle herd in northern Minnesota was found positive in the summer of 2005. In the last four years, an additional 11 beef cattle herds were found TB-positive in the same area. Twenty six infected free-ranging white tailed deer were harvested during the hunting seasons and by USDA Wildlife Services sharpshooters in this area during that time. The Minnesota Board of Animal Health and its partner agencies contained the infection and are hopeful that it has been eradicated. We focused our financial and personnel resources on the area where the disease is known to exist and conducted aggressive depopulation of both livestock and wildlife in the area. Deer exclusionary fencing was constructed to mitigate livestock and wildlife interaction. Movement controls on cattle and additional wildlife surveillance will ensure that the disease is no longer in the area and is not reintroduced.

Minnesota currently has Split State Status for TB- with a majority of the state being Modified Accredited Advanced (MAA) and a small 2,600 square mile zone being Modified Accredited (MA). A third, smaller area where we have found the infected deer is known as the Management Zone. A majority of our work, such as the cattle herd buyout and fencing program, has taken place within the Management Zone. No new livestock is allowed to be brought into the area. All of the herds in the MA Zone, which includes the Management Zone, must have an annual TB test and undergo a wildlife risk assessment to identify potential weak points in premises biosecurity. Animal Movement Certificates, official ID and a 60-day TB test are required for all cattle moving into, out of, or within the MA Zone. Local law enforcement is assisting the Board by stopping vehicles hauling livestock to ensure that the animals are being moved lawfully. Surveillance testing is ongoing in the MAA Zone. Almost 600,000 cattle have been tested in Minnesota since 2005. There have not been any TB-positive animals found in the MAA Zone.

Managing Bovine TB in Minnesota's Wildlife

Erica Butler, Minnesota Department of Natural Resources

In response to the disease being detected in cattle, the Minnesota Department of Natural Resources (MNDNR) began surveillance efforts in free-ranging white-tailed deer (*Odocoileus virginianus*) within a 15-mile radius of the infected farms in fall 2005. To date, 26 deer have been found infected with Bovine TB. All infected deer were sampled within a 164mi^2 area, called the Bovine TB Core, which is centered in Skime, Minnesota, and encompasses 8 of the 12 previously infected cattle farms. In fall 2008, Minnesota was granted a Split-State Status for Bovine TB by the United States Department of Agriculture (USDA) that resulted in a lessening of testing requirements for cattle in the majority of the state (status level = "Modified Accredited advanced"), with a small area in northwestern Minnesota remaining more restrictive (status level = "Modified Accredited"). Also in 2008, the Minnesota State Legislature passed an initiative that allocated funds to buy-out cattle herds located in the Bovine TB Management Zone, spending $3 million to remove 6,200 cattle from 46 farms by January 2009; resulting in the discovery of the 12th infected cattle herd. The remaining cattle farms in the Bovine TB Management Zone (*n* = 27) were required to erect deer-exclusion fencing to protect stored forage and winter feeding areas, costing an additional $690,000 in state funds. In November 2008, the MNDNR conducted Bovine TB surveillance of hunter-harvested white-tailed deer within the newly created Modified Accredited Zone, and results indicated that none of the 1,246 deer tested were positive for the disease. This marked the first large scale surveillance effort that failed to detect the disease in hunter-harvested deer since sampling efforts began in 2005. MNDNR also conducted targeted removal operations in the Bovine TB Core Area, using both aerial and ground sharpshooting, during winters 2007, 2008 and 2009. These intensive winter deer removal operations removed a combined total of 2,163 deer and detected 14 (54%) of the TB-positive deer discovered to date. Further, a recreational feeding ban, covering 4,000mi^2 in northwestern MN, was instituted in November 2006 to help reduce the risk of deer to deer transmission of the disease and enforcement officers have been working to stop illegal feeding activities. The MNDNR will continue to conduct hunter-harvested surveillance for the next 5 years to monitor infection in the local deer population, and consider the continuation of aggressive management actions (e.g., sharpshooting deer in key locations) to address concerns of deer becoming a potential disease reservoir.

Chronic Wasting Disease Update

Dean Goeldner, USDA-APHIS-Veterinary Services.

In FY 2009 APHIS received approximately $17 million in appropriated CWD funding, including $1.5 million in congressional earmarks. CWD rule update: The proposed supplemental rule for CWD was published for comment in the Federal Register on March 31, 2009. The proposed rule preserved the principle of federal preemption regarding interstate movement restrictions for CWD but did not affect state movement restrictions for other reasons. It also increased the surveillance requirement for interstate movement to 5 years, or certified status in the program. Finally, it proposed to create a 25 mi/40 km proximity standard to occurrences of CWD in wild cervids for those states seeking additional risk mitigation. Other issues such as inventory, quarantine, DNA comparison and wildlife surveillance requirements were also addressed.

APHIS is drafting responses to the comments received and is discussing internally what direction the revised final rule will take. Issues that may impact the revised final rule include the president's memo on federal preemption dated May 20, 2009; budgetary constraints; the 2015 vision for Veterinary Services; and the need to create a truly cooperative state-industry-federal program that works for all stakeholders.

APHIS intends to publish and implement the revised final CWD rule in 2010.

In FY 2009, 23,652 farmed and captive cervids were tested for CWD using immunohistochemistry. This continues an increasing trend that is likely the result of industry growth and stricter enforcement of state regulatory programs.

Five positive farmed cervid herds were detected in FY 2009: Two white-tailed deer herds in Wisconsin, one elk herd in Minnesota, and two elk herds in Colorado. The Wisconsin and Minnesota facilities have been depopulated. This brings to 47 the number of positive herds that have been identified since 1997. At this time, six positive elk herds remain in Colorado. VS continues to offer indemnity and cover depopulation, disposal and testing costs for CWD-positive and exposed herds and trace animals.

In FY 2009, $4.65 million in CWD cooperative agreement funding was made available to the state wildlife agencies. The funding levels in the tier system developed in consultation with AFWA were reduced slightly from FY 2008 due to budgetary constraints. Forty-nine states requested and received funding. VS provided $560,000 to support tribal CWD activities in FY 2009. In addition to the ongoing

cooperative agreement with the Native American Fish and Wildlife Society, 27 individual tribes received CWD assistance.

In the face of increasingly tight state and federal budgets and fatigue with resource-intensive hunter-killed surveillance activities, new surveillance strategies are needed to monitor geographic distribution and prevalence of CWD. The agriculture appropriations bill/conference report for FY 2010 contains $16.875 million for CWD, including a $1.024 million earmark. After overall agency needs are determined, VS will continue to work with AFWA to assure an equitable distribution of cooperative agreement funding.

VS2015 is an initiative to provide a new vision and direction for VS programs. The emphasis will be away from traditional, large scale eradication activities and toward a focus on prevention, preparedness, detection and response. This initiative will have implications for the future of the CWD program.

Concept Paper for a New Direction for the Bovine Brucellosis Program

Brian McCluskey, USDA Veterinary Services

Bovine brucellosis is a serious disease of livestock that has significant animal health, public health and international trade consequences. The cooperative Federal-State-Industry effort to eradicate the disease from cattle in the U.S. has been successful.

The concept paper, recently published in the federal register for public comment, presents APHIS, Veterinary Services' current thinking about changes we are planning to address these challenges. The concept paper provides an action plan that:

1. Effectively demonstrates the disease-free status of the United States through a national status-based program supported by a national surveillance strategy.
2. Enhance efforts to mitigate disease transmission from wildlife.
3. Enhances disease response and control measures.
4. Modernizes the regulatory framework to allow Veterinary Services to address risks quickly and sensibly.
5. Implements a risk-based disease management area concept.

To succeed, this new approach will require Veterinary Services' continued partnership with State Animal Health and wildlife officials, other federal agencies, industry, international partners, academia, and other stakeholders. Successful partnerships will allow us to use available resources efficiently to achieve program objectives and protect our national livestock herd.

The action plan will benefit Federal and State animal health officials, the regulated industries, and producers by allowing a more adaptable science-based response that is both effective and timely and that addresses the unique challenges facing the program today.

Montana Perspective on Brucellosis Plan

Martin Zaluski, Montana State Veterinarian

In July 2009, Montana was Classified Brucellosis Free, and consequently all 50 states in the Nation have been declared free of brucellosis in livestock. Montana will continue the Brucellosis Action Plan through January 10th, 2010 (6 months following reclassification to Class Free), at which time the area for livestock surveillance and risk mitigation activities will be adjusted. The 2008 elk surveillance (mostly hunter harvest) yielded 880 usable samples. Of the 880 samples, 62 (7%) were seropositive on standard serologic tests, and 13 (1.5%) were determined to be positive on western blot. Western blot positive elk were found in 5 hunting districts (HD) in the 2008 surveillance and in 4 HD in 2007 surveillance. The road ahead includes continuation of wildlife surveillance, adjustment of the livestock surveillance area, continuation of risk mitigation activities in livestock, and development of objective tools to assess risk of transmission and risk mitigation.

Wyoming Brucellosis Update

Terry Kreeger, Wyoming Game and Fish Department

Terry Kreeger reported on Brucellosis wildlife risk mitigation authorities in Wyoming. Surveillance activity includes testing of samples submitted by hunters from elk killed in specific hunt areas each year as well as sampling elk trapped or killed I the Designated Surveillance Area annually. This testing has identified increased seroprevalance in Western Park County (east of YNP) which is an area where there are no elk feedgrounds. The test and removal pilot project on three elk feedgrounds in Sublette County is in the fifth and final year. This project has shown a decrease in seroprevalance in elk in each of the past three years and test and removal will remain a tool for future use in strategic locations. Prevention

activities in clued vaccination with strain 19 or 2 of the 23 elk feedgrounds. Elk feeding is one mechanism used to attract elk away from cattle feedlines and to prevent co-mingling. WGFD is shortening the feeding season as weather allows and is experimenting with feeding techniques to attempt to reduce the contamination of elk and to spread them out of the feedground to avoid exposure. Research efforts include Brucella/Yersinia diagnostic chute side test development and vaginal implant transmitter studies. The WY Livestock Board and the WGFD are also working with the USFWS and the Wind River Indian Reservation to conduct surveillance activities on elk on the reservation which is adjacent to Wyoming's Designated Surveillance Area.

Epizootic Hemorrhagic Disease

David Stallknecht, University of Georgia

David Stallknecht gave an update on bluetongue and epizootic hemorrhagic virus isolations during 2008 and 2009. In 2008, isolations were made from wild and captive white-tailed deer in Arkansas (BTV-3), Indiana (EHDV-2), Kansas (EHDV-2, EHDV-6), and Texas ((EHDV-1, EHDV-2, EHDV-6, BTV-12, BTV-17). As of October 9 this year (2009), viruses have been isolated from white-tailed deer in Florida (EHDV-2), Kansas (EHDV-2), Louisiana (EHDV-2), Michigan (EHDV-6), Missouri (EHDV-2), Tennessee (EHDV-2), and Texas (BTV-17). BTV-3, BTV-12, and EHDV-6 all represent viruses that were not know to occur in the United States prior to 1999 (BTV-3), 2006 (EHDV-6), and 2008 (BTV-12). There have been multiple isolations of BTV-3 and EHDV-6 suggesting that these viruses are established.

A Tale of 2 Lice: "Hair-loss Syndrome" in Western Deer Populations

Colin Gillin, Oregon Department of Fish and Wildlife

Exotic species enter the US each year, with the majority of these intruders small enough in size to escape detection by focused state and federal surveillance. In the past 3 decades, USDA has collected over 70 different species of arthropods at entry ports, most encompassing tick species (Amblyomma spp.) and screwworm (Cochliomyia spp.).

The greatest threat of introduced species may be to livestock health and threats to the nation's food source and economy, but also native wild species and habitats (Zebra mussels) or human health (West Nile virus). Equally at risk are native species of wildlife (West Nile virus on corvids and sage grouse and potentially the fungus that causes White Nose syndrome in bats of the northeastern US).

Arguably the consequences of introduced species on those considered endemic is that the effected populations may serve as a naive host, which may have a more severe reaction to introduced pathogens or parasites due to a lack of developed immune response defenses. Since 1996, the effects of apparent exotic louse species on western deer populations has wildlife managers increasing efforts in surveillance, management and research to understand, combat, and develop strategies.

A condition causing what appeared to be alopecia or hair-loss in black-tailed deer (Odocoileus hemionus columbianus) was first described in western Washington in 1996. Durign the initial evaluations, heavy infestations of a chewing louse from the genus Damalinia spp. was observed. Perliminary diagnoses determined the species to be a more common species found throughout North America (*Damalinia (Subgenus Tricholipeurus) lipeuroides and parallelus*. Within a year, the louse was further characterized and determined to be an Old World species Damalinia (Cervicola) spp, a common louse of fallow deer from southeast Asia. Affected deer develop a hypersensitivity reaction, causing excessive grooming and eventual loss of hair.

The geographical distribution of this condition termed Hair-loss Syndrome (HLS) contined expantion into Oregon in 1998 and is now present in black-tailed deer popualtions west of the Cascades from the Canadian border to northern California. Many deer have been observed in poor condition in the winter with evidence of mortalities from complications of pneumonia and hypothermia. This severe reaction of a parasite on it's macrovertebrate host is not typically witnessed over such a large scale. Theories as to why deer were affected include cofactors of immunosuppression from viral infections, parasite burdens, environmental contaminations or toxins, or stress from poor nutrition and changes in habitat. Changing climate patterns were also evaluated along with the potential of introduced intermidiate hosts.

Initial necropsy results showed deer with severe emaciation and alopecia, verminous pneumonia from *Dictyocaulus spp. and Protostrongylus sp.*, with pediculosis involving heavy infectations of chewing lice, peripheral lymphadenopathy from stimulation of the immune systemand other high internal parasite burdens (*Parelaphostrongylus odocoilei*).

With little known about the specific mechanisms related to this condition, research was conducted at Oregon State University during 2002-05 J. Robison and B. Coburn. Some of their results showed that *D. cervicola* could be transmitted to mule deer and that lice are able live off their host for several days in cool temperatures and up to a week at room temperature. They also found that deer that were severely affected but survived were able to grow a normal hair coat following seasonal shedding and hair regrowth. Lice numbers were highest from December through May and lowest June through Novemeber. During peak periods, lice numbers could exceed 20-30 times the number per square cm versus the summer months. Other research showed that pevalence of HLS does not appear to affect winter fawn survival (Bender and Hall 2004)

Despite mortalities attributed to HLS, and the opinions of some wildlife managers that HLS has contributed to localized declines in black-tailed deer, studies conducted to date have not demonstrated significant population impacts on black-tailed deer.

In 2003, the Washington Department of Fish and Wildlife (WDFW) began receiving reports of HLS in deer east of the Cascades, at the black-tailed deer - mule deer (Odocoileus hemionus hemionus) intergrade zone. Lice were collected from deer and identified as Bovicola tibialis, the chewing louse of fallow deer (Dama dama). This species of louse has been reported in the US since 1941 in British Columbia and Califoria in 1973. It is thought that exotic lice have potentially been in North America for at least 100 years or since shipments of foreign species of cervids were introduced into this continent. In 2006, numerous reports were received of dead deer (particularly fawns) with hair loss in south central Washington, and these carcasses were heavily infested with Bovicola tibialis. The number and geographical distribution of reports of HLS in eastern Washington deer have increased steadily over the past 6 years, with reports in Idaho, Wyoming, Nebraska, California and Canada. Deer surveys and harvest data suggest mule deer populations in some affected areas have declined by an estimated 50% since 2004. It is unknown if Bovicola tibialis infestations are the sole reason for the decline, but they are suspected to be a factor.

The question remains whether invasive and foreign insects such as *Damalina cervicola* and *bovicola tibialis* were simply unknowingly introduced into the North American continent on the backs of Asian cervids or if the parasite has been on this continent for much longer. Broader question involves determinig the impacts to populations of endemic North American cervid species and why this parasite suddenly seems to cause such increasing and unexpected pathological ramifications on its host to the potential detriment of cervid populations.

Anthrax in a large semi-free Ranging Bison herd

Dave Hunter,Turner Endangered Species Fund

During period from July 27th through August 17, 2008 anthrax was diagnosed in a bison herd in Southwestern Montana. The outbreak was the first recorded anthrax outbreak in that region. The death loss started following a period of severe thunderstorms and hail followed by several days of temperatures exceeding ninety degrees F. There were 5,000 bison on an 18,000 acre pasture and the bison were in the middle of rutting behavior. The working and handling facility was not accessible during the outbreak due to distance from the quarantine pasture and behaviors of the animals. Several different strategies were used to remove carcasses, curtail additional deaths and to prevent bioaccumulation of spores. Due to the extremely dangerous fire conditions on the ranch the State of Montana provided a curtain incinerator for carcass disposal. The incinerator could only handle 8-9 bison per day and the death losses were climbing to thirty animals per 24 hour period. Foam developed for military anthrax decontamination (EasyDecon DF 200 Manufactured by Intelagard) was then incorporated into a burial protocol. The remaining carcasses were buried to a depth of six feet after foaming and sprayed with a 10% bleach solution. The death loss was approximately 5% or 298 bison from the herd of 5,000. Males suffered a higher death loss as 39% of breeding males were lost during the outbreak. Elk death lost during the disease was confined to males only. Thirty five to forty adult bulls were found dead with antlers in velvet around the quarantine area. Elk do not elicit fighting behavior when the antler is in velvet eliminating aggression as a cause of spread of the organism. One hundred and twenty nursing calves were orphaned during the outbreak. No scavengers fed on any carcass that died during the outbreak. Biting flies were not trapped during the first year. In 2009 a team from Environmental Protection Agency (EPA) sampled grids around burial sites and riparian areas attempting to recover spores to test our burial protocols. Flights to monitor elk populations this year did not reveal losses during the anthrax season. A vaccine trial was initiated to identify vaccine dosage that would offer protection for animals for 10-12

months. The standard vaccine protocol is two doses two weeks apart. Since the vaccine is usually given prior to the anthrax season it is labeled for six months protection. Using a double dose of the standard vaccine using pneumatic injectors (MIT Technologies) appeared to offer additional protection with one injection.

Is There a Role for Serologic Testing in Wild Bird Avian Influenza Surveillance?
David Stallknecht, Southeastern Cooperative Wildlife Disease Study, University of Georgia

Dave reported on research evaluating the efficacy and potential applications of serologic testing as a diagnostic tool in wild bird AI surveillance. Since the emergence of H5N1 highly pathogenic AI virus, there has been an increased effort put into wild bird AI surveillance, globally. While a large part of this surveillance effort has been devoted to detecting the introduction of H5N1 highly pathogenic AI viruses, there has also been a movement toward better understanding the natural history of these viruses and further defining the epidemiology of AI in wild birds. Currently, AI surveillance in wild birds is largely dependent on diagnostic assays that detect viral shedding, including virus isolation and reverse transcriptase polymerase chain reaction (RT-PCR). This surveillance approach has successfully isolated AI virus from over 100 taxonomically diverse avian species and identified two groups of wild bird reservoir hosts; species in the Orders Anseriformes and Charadriiformes. Testing for antibodies to AI virus is a common surveillance strategy utilized in domestic poultry to screen for infection on a population level. This approach has been underutilized in wild bird AI surveillance because serologic assays developed and utilized for domestic galliforms lack sensitivity in some wild bird species, particularly waterfowl. A sensitive and specific assay to detect AI antibodies in wild birds would represent a valuable complement to existing virus isolation- and RT-PCR-based surveillance. Serologic data could help interpret virus isolation and RT-PCR results and also serve as an economical method to help identify species or populations involved in AI epidemiology. The goal of this research was to evaluate the ability of a commercial blocking enzyme-linked immunosorbent assay (bELISA) and the agar-gel immunodiffusion (AGID) test to detect antibodies to AI viruses in field and experimental serum samples collected from a large diversity of wild avian species. The commercial bELISA utilized in these studies was the IDEXX Flockchek AI MultiS-Screen Ab ELISA (IDEXX Laboratories, Westbrook, ME).

We first tested 281 serum samples collected from 28 taxonomically diverse wild avian species that were experimentally infected with AI viruses with both assays. These samples included 178 from birds with confirmed AI infections (122 infected with low pathogenic AI viruses and 56 with highly pathogenic AI viruses) and 103 from uninfected negative control birds. The sensitivities of the bELISA and AGID tests were 0.820 (95% CI: 0.756-0.874) and 0.674 (0.600-0.742), respectively. Both tests had an estimated specificity of 1.00 (95% CI: 0.965-1.00). The bELISA was significantly more sensitive than the AGID for both LPAI- and HPAI-infected birds and yielded a higher sensitivity estimate that the AGID for all 28 species.

To further evaluate the performance of the bELISA and AGID, we tested 2,249 field serum samples collected from 62 wild bird species, representing ten taxonomic orders, with both assays. The bELISA detected 25.4 % positives from these samples, while the AGID test detected 14.8%. As with the experimental samples, the bELISA detected as many or more positive samples than the AGID test in all 62 species. The serologic results yielded by both assays were consistent with the known epidemiology of AI virus and previously published virus detection data (virus isolation and RT-PCR). Most positive samples were from aquatic birds and the highest prevalences were from species in the Orders Anseriformes and Charadriiformes. Positive serum samples were rarely detected in terrestrial avian species.

Taken together, the experimental and field serology data from these studies suggest the evaluated commercial bELISA is a more sensitive serologic assay than the AGID test for detecting antibodies to AI virus in wild birds. Based on these results, the bELISA is a reliable species-independent serologic assay. Specific examples of potential field-relevant applications will be discussed.

Wildlife Disease Activities Report
Seth Swafford, USDA/APHIS Wildlife Services

Wildlife Services (WS) National Wildlife Disease Program continued to partner with State Agriculture Departments, State Wildlife Agencies, Veterinary Services (VS), and others to implement its Surveillance and Emergency Response System. Through the surveillance component, comprehensive feral swine disease sero-surveillance was implemented by sampling approximately 2,500 feral swine in 32 states

during federal fiscal year 2009. Diseases of most interest and concern were swine brucellosis, pseudorabies, classical swine fever, toxoplasmosis, and trichinae; preliminary results were provided. Twenty-nine states actively participated in collecting samples for plague, tularemia, or both during federal fiscal year 2009. A total of approximately 5000 animals were sampled (2 samples/animal) using the Nobuto strip blood collection technique. All of the collected samples were sent to the Centers for Disease Control for diagnostic testing. Bovine tuberculosis (bTB) issues involving wildlife have become increasingly more important during the past fiscal year. For example, WS worked with State Agriculture Departments and State Wildlife Agencies in Minnesota, Nebraska, Michigan and Indiana to conduct surveillance in captive and wild cervids as well as other species of wildlife. Surveillance for highly pathogenic avian influenza (HPAI) continued as another area of emphasis for WS. Biological year 2008 (BY08) represented the third year of surveillance coordinated at a national and flyway level. During BY08, WS and State Wildlife Agencies collected 64,741 wild bird samples from 50 U.S. States and 25,976 environmental samples for the early detection of HPAI. Coordination with Mexico and Canada provided a continental approach regarding wild bird surveillance. Samples from the U.S. were screened at National Animal Health Laboratory Network facilities and forwarded to the National Veterinary Services Laboratories (NVSL) for confirmation. Five-hundred seventy-six samples from 42 states were confirmed LPAI H5 positive by NVSL. One-hundred seventeen samples from 31 states (out of 259 sent for confirmation from 34 states) were confirmed by NVSL as H7 positive. Of the 25,976 fecal samples collected during BY08, there were 246 matrix positive pools. Of the matrix positive pools, 4 pools from 2 states screened H5 positive and were sent to NVSL for confirmation. One of the 4 pools was confirmed positive. The national surveillance effort has not detected any HPAI in the United States during the 3 years of surveillance.

Results from the Department of the Interior Avian Influenza Surveillance Program
Scott Wright, National Wildlife Health Center

This is a presentation on the activities of the Department of the Interior (DOI) toward the National Surveillance Plan for the Early Detection of Highly Pathogenic Avian Influenza in the United States. The DOI, through the cooperation of the Flyway Councils, Department Bureaus, State and Tribal wildlife management agencies and NGOs, has sampled over 84 thousand birds in Alaska, the lower 48 states, Hawaii and the Pacific Islands since April 2006. To date, highly pathogenic H5N1 avian influenza Asian strain, has not been detected. However, low pathogenicity avian influenza viruses have been detected via the PCR test in 2,132 birds (2.5%). Virus isolation (VI) in live chicken eggs has been conducted on 32,906 birds which resulted in the isolation of 1,185 viruses (3.6%). All HA subtypes except H14 and H15 have been detected and all nine neuraminidase subtypes have been detected. The Northern Shoveler has the highest percentage of both PCR and VI positive samples of all 257 species sampled. Throughout the geographic sampling area, 106 sample sites (9%) of a total of 1,140 sample sites account for 66% of PCR positive birds. Strategic sampling early in the avian influenza season in Alaska yields a spike in virus prevalence as a result of birds arriving into the area. A comparison of sample types (oral, cloacal, laboratory combined and field combined swabs) revealed that the field combined swab sample is more often PCR positive and yields more viruses than the other three sample types.

White-Nose Syndrome: An Emerging Fungal Pathogen
Scott Wright, National Wildlife Health Center

This presentation describes a novel pathogen that is affecting wild bats. We also report some of the early findings discovered over the last year. White-Nose Syndrome (WNS) is a recently described fungal disease that is occurring in at least 6 species of insectivorous cave hibernating bats in the Northeast. This event is unprecedented in bats. At no time in recorded history has there been a disease this destructive to bats anywhere on earth. First detected in New York, WNS is now known to exist in another eight states and there is considerable concern that WNS is spreading. The novel fungus of WNS is a newly described species *Geomyces destructans.* The fungus flourishes on the muzzle and wings of bats resulting in fuzzy white noses. *Geomyces destructans* is psychrophilic growing best in cold temperatures. The fungus also invades intact skin as a primary pathogen. Lesions on the wings of bats compromise normal wing function which includes, flight, heat dissipation, water control, gas exchange and blood pressure regulation. Affected bats often roost abnormally at cave entrances, fly outside caves during winter months and die in very large numbers. Estimates of cave populations indicate losses of up to 90% and overall losses are over 1 million bats in three years. Fungal infection may take more than one year to

adversely affect bats. There are several theories about the affects of fungal infection including infection disrupts torpor causing bats to abnormally arouse and use stored energy resulting in wasting. Affected bats are often emaciated. Ecologically bats are important predators of insects, consuming vast quantities during foraging flights at night. Although the popular press has suggested that human disease will increase because there are fewer bats to eat mosquitoes, in fact, bats do not eat mosquitoes, they feed instead on moths. The greatest economic and ecologic affect from reduced insectivorous bat populations is destruction of forests by tree eating caterpillars.

There is evidence that WNS may also occur in several countries in Europe as far back as the early 1980s. Bats affected with WNS-like fungus have been reported in Germany, France, Czech Republic, Hungary, Switzerland, Romania, and the Netherlands. In contrast to North America, the occurrence of WNS in bats in Europe has not resulted in massive die-off events. However, bat colonies in Europe are considerably smaller. Europe and North America do not share bat species and the possibility of transoceanic movement of bats is not known. Work is underway to compare fungal isolates from the two continents by genetic sequencing.

Federal and state agencies, NGOs, and universities have collaborated to investigate the occurrence of WNS in the Northeast. As the disease is detected in new areas, more states ramp up their cave surveillance to try to detect WNS as soon as possible. Control measures are under development and a National Plan is being written to better coordinate activities related to WNS.

Committee Business

The Committee reviewed the USAHA Joint Working Group Committee of Wildlife Diseases and Committee of Sheep and Goats Recommendations on best management practices for domestic sheep grazing on public land ranges shared with bighorn sheep. The Committee approved the recommendations in their entirety.

The committee reviewed a resolution on wildlife immunocontraception using Gonacon, a USDA Wildlife Services product. The resolution was tabled until next year.

The Committee reviewed 3 other resolutions titled 1)Investigation of Risk Posed by Emerging Pestiviruses; 2) Research and Management of Bighorn Sheep/Domestic Sheep Disease; and 3) Enhanced Development of Risk Assessment Models by Determination of United States Wildlife to Rift Valley Fever Virus. All three resolutions were approved and forwarded to the Committee on Nominations and Resolutions.

USAHA Joint Working Group
Committee of Wildlife Diseases & Committee on Sheep and Goats
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Recommendations on best management practices for domestic sheep grazing on public land ranges shared with bighorn sheep

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Introduction

In October 2007, the United States Animal Health Association (USAHA) Committees on Wildlife Diseases and Sheep and Goats established a working group comprised of staff or members of state and federal animal health agencies, wildlife and public land management agencies, the American Sheep Industry and Wild Sheep Foundation (formerly Foundation for North American Wild Sheep (FNAWS)). The working group was charged with developing best management practices for grazing domestic sheep (and goats) on public lands where contact between domestic sheep and bighorn sheep may occur. This working group concept was subsequently endorsed by USAHA as part of a broader resolution on "Cooperative Research and Management of Wildlife/Livestock Disease Interactions" approved in October 2007. The task of this subcommittee was limited to one specific aspect of domestic sheep management, the interaction of bighorn sheep and domestic sheep on public lands. Consistent with USAHA direction, this document primarily focuses on the domestic sheep portion of best management practices in these situations. A comprehensive list of best management practices for bighorn sheep can be found in the Western Association of Fish and Wildlife Agencies (WAFWA) Bighorn Sheep Working Group Recommendations for Domestic Sheep and Goat Management in Wild Sheep Habitat (1).

Although public lands grazing is a privilege and agencies are not required to offer alternative allotments for domestic sheep grazing, work group members recognize the historical role that public land grazing has played in sustaining viable working landscapes and rural communities, and that domestic sheep and goats, as well as bighorn sheep, are important to the cultural and ecological heritage of most western states. The work group also recognizes that domestic livestock grazing can be a useful tool for habitat management. The working group, co-chaired by Drs. Walt Cook and Michael Miller, assembled relevant background information and met via multiple teleconferences, email and in person at the 2008 USAHA meeting to develop and discuss recommended best management practices. As per the group's charge, the recommendations that were developed focus on practices intended to minimize opportunities for interspecies contact on shared range that could lead to transmission of respiratory pathogens. In some recent pneumonia epidemics in bighorn sheep, the cause has been attributed to endemic respiratory pathogens, and in other epidemics the cause has been attributed to pathogens introduced via interactions with domestic sheep (2). These recommendations do not presume to estimate the probability or risk of contact. Quantifying the risk of interspecies disease transmission between bighorn sheep and domestic sheep in a natural setting is problematic (2). Further research is needed to better understand and estimate the magnitude of potential risk to bighorn sheep arising from interactions with domestic sheep and other wild ruminant species, as well as the risks of endemic disease and potential influences of seasonal and environmental factors on these risks. Indeed, the original USAHA resolution that led to this working group directed federal agencies to fund research on epidemiology and pathogenesis of bighorn/domestic sheep disease interactions.

These recommended best management practices are intended to serve as one element of more comprehensive approaches for managing the health of bighorn sheep populations. We recognize that all of the management practices listed may not be incorporated into some management plans, but offer them as a complete list for consideration. Hopefully these recommendations will complement or emphasize risk reduction practices already in place, and encourage their development elsewhere. Although national in scope, these recommendations do not mandate programs at the state, local, or tribal level. Local primacy dictates that management occurs at the state or regional level whenever possible. The work group members believe that these recommended best management practices represent a viable alternative to terminating domestic sheep grazing on public lands where goals include minimizing the risk of epidemics in bighorn sheep that may result from interspecies contact. However, there are cases where these practices have been considered and mutually judged to be infeasible by responsible agencies and permittees or their representatives in the course of negotiations via established processes for timely conflict resolution. When this occurs, the work group members encourage timely identification of alternative grazing allotments or arrangements to minimize impacts on permittees and interruption of ongoing domestic sheep operations.

RECOMMENDED BEST MANAGEMENT PRACTICES FOR GRAZING DOMESTIC SHEEP (AND GOATS) ON PUBLIC LANDS WHERE CONTACT WITH BIGHORN SHEEP MAY OCCUR:

Domestic sheep husbandry

1. Select only highly gregarious breeds of sheep (e.g., Merino, Rambouillet, "Western/white-faced ewes", fine wools and crosses thereof) for grazing on shared ranges.

2. Use pregnant domestic ewes or ewe-lamb pairs (i.e., ewes with lambs) for grazing near occupied bighorn sheep habitats; avoid grazing open ewes, yearling replacement ewes and ewes that have lost their lambs because ewes in estrus attract bighorn rams.

3. Maintain a band size of less than 900 ewes with single lambs (1,800 total) or 700-800 ewes with twin lambs (2,100 to 2,400 total), or of less than 1,500 dry ewes or yearlings.

4. Require instruction/training and supervision for ranch (i.e. camp tenders and sheepherders) and agency staff members and frequent instructions to the sheepherders concerning locations where forage and water is available for domestic sheep and monitor that the grazing standards and guidelines are being followed.

5. Require instruction/training and supervision for ranch (i.e. camp tenders and sheepherders) and agency staff members and frequent instructions to the sheepherders concerning recognizing bighorn sheep and allowable methods for preventing contact between bighorn sheep and domestic bands.

6. Place more experienced, informed, and responsible sheepherders on allotments located nearest to bighorn sheep habitats.

7. Place mature and effective guard dogs and herding dogs with domestic sheep (at least 2 of each per band). Female dogs in heat should not be placed on allotments.

8. Conduct full counts of all individual ewes when moving onto and off of each allotment.

9. Maintain an appropriate ratio of marker sheep within bands; depending on local needs and conditions, ratios should be no fewer than 1 marker for every 100 adult sheep. More markers may be required when dictated by local conditions.

10. Count marker sheep on a regular basis, immediately any time sheep scatter and more frequently (e.g., once or twice per day) if required under local grazing agreements. It is customary to count marker sheep when they are bedded and this should be encouraged. After sheep scatter, complete a full count as soon as reasonably possible.

11. Place bells on at least 1 in every 100 mature ewes to serve as warning, and for identification and location of sheep relative to other sheep.

12. Select camp locations and bedding grounds that are acceptable to sheep and encourage sheep to remain within the bedding grounds.

13. Select herder's camp, nighttime bedding ground, and midday (siesta) bedding ground locations that maintain communication between guard dogs and herding dogs by smell, sound (barking) and sight, and to take advantage of differences in the sleep cycles of guard dog and herding dog. If grazing federal lands, comply with established "bed ground" standards. Construct temporary electric or boundary fences in congregation areas (e.g., bed grounds) where feasible.

14. Truck in water (if needed) to prevent straying.

15. In situations where sheep are difficult to observe because of dense vegetation or difficult terrain, always count marker sheep after emerging from such conditions.

16. Increase sheepherder vigilance on bright moonlit nights because sheep may rise to graze under these conditions.

17. Truck domestic sheep through "driveway" areas that include occupied bighorn sheep habitat where interspecies contact is considered likely by the land management agency staff in consultation with the state wildlife management agency staff. It is not always possible to truck sheep into certain rugged areas; in these cases other arrangements may need to be made.

18. Do not trail more than 5 miles per day and stop trailing when sheep or lambs show signs of fatigue. Provide for a "babysitter" or removal of lagging sheep when trailing. Follow additional agency guidelines (where applicable) on federal lands.

19. Remove sick or physically disabled domestic sheep from the band.

20. Require that sheepherders use communication equipment such as cellular or satellite phones or two-way radios (when service is adequate) and location equipment such as global positioning system (GPS) receiver to report and record grazing movements and encounters with bighorn sheep. Seek cost-sharing partnerships for providing electronic and other equipment when an operator changes grazing management practices for the sole purpose of minimizing domestic sheep contact with bighorn sheep; these partnerships could include wildlife management agencies and private organizations.

21. Have sheepherders use a log book or other record keeping aids to record GPS locations, counts, losses, and other information as needed or required.

Domestic goat husbandry

Because domestic goats are less gregarious than domestic sheep and have a greater tendency to stray or disperse, the work group recommends that domestic goats are not grazed in occupied bighorn sheep habitat.

When goats are grazed near bighorn sheep for weed control or other purposes, electric fencing can be used to keep the two species apart. Pack goats used in bighorn sheep habitats should be tethered when not being trailed.

Strays & commingling responses

1. Develop a commingling detection and response protocol that includes the following:
   a. reporting bighorn sheep (including a count and GPS location) that are attempting to associate with domestic sheep bands;
   b. reporting stray or missing domestic sheep to the land management agency;
   c. immediate, two-way notification (between permittee and land management agency) of actual commingling sightings;
   d. a post turn-off stray domestic sheep removal protocol;
   e. a protocol for removing individual commingling bighorn sheep;
   f. where feasible, collect standardized diagnostic samples on stray domestic sheep and commingling bighorn sheep;
   g. instructions for domestic sheep herders to not leave sick domestic sheep behind when trailing or moving from or between allotments.

2. Develop and follow a plan for locating and reacquiring (dead or alive) stray sheep. If a domestic sheep is determined to be missing, the permittee will immediately initiate a comprehensive search and notify the land manager.

3. Allow/encourage the permittee or producer and appropriate agency representatives to remove any stray domestic sheep in areas where interspecies contact could occur.

4. Allow/encourage the permittee or producer and appropriate agency representatives to haze bighorn sheep that appear intent on commingling.

5. Allow/encourage the permittee or producer and/or appropriate agency representatives to remove commingling bighorn sheep.

6. Where not already established, develop or clarify legal authorities for removing stray domestic sheep from public lands by lethal means.

7. Encourage voluntary allotment monitoring by permittees or independent observers in conjunction with federal and state agencies; where used, independent observers should receive prior training from permittees or agency personnel.

8. Develop pilot incentive/recognition programs to foster and recognize compliance, cooperation, and cost-sharing in efforts to prevent commingling of bighorn sheep and domestic sheep on shared ranges.

Allotment boundary & habitat manipulations

1. Review domestic sheep allotment boundaries and/or use and reconfigure where appropriate and feasible to avoid or minimize overlap with critical bighorn sheep habitat. Where feasible, use strategies and techniques including:
   a. geographic/topographic barriers that enhance species separation;
   b. seasonal or spatial separation through domestic sheep grazing management.

2. Undertake habitat enhancements that improve bighorn sheep habitats (both summer and winter range) outside allotment boundaries and/or attract bighorn sheep away from domestic sheep allotments.

3. Undertake water developments to enhance bighorn sheep distribution or to move domestic livestock away from preferred bighorn sheep foraging areas by augmenting available natural water sources.

4. Where appropriate and feasible, determine the number of domestic sheep animal unit months (AUMs) that overlap bighorn sheep habitat and negotiate among cooperators (state, federal, industry, private) to locate potentially available replacement AUMs or allotments if necessary.

Other bighorn sheep management practices

1. Manage for bighorn sheep population densities and distribution that reduce potential for interspecies contact.

2. Use hunting and/or other means to discourage bighorn sheep from using domestic sheep allotments where alternative suitable habitats are available.

3. Use hunting and/or other means to discourage bighorn sheep from staying in proximity to or approaching domestic sheep bands.

4. Remove all sick or dead bighorn sheep encountered.

The foregoing best management practices are based on current understanding about the circumstances leading to pasteurellosis epidemics in bighorn sheep after contact with domestic sheep. Improved understanding about this relationship and about controlling respiratory diseases in sheep in general should allow refinement of these practices. Research needs to be funded; federal, state and non-profit agencies and organizations are all encouraged to fund research. For example, developing methods

that decrease the occurrence or severity of pneumonia and pasteurellosis in either domestic or bighorn sheep, including the development and use of vaccines, immunostimulants, or long-acting therapeutic agents, might lead to advances in managing both. Outcomes of such research could aid in decreasing risks posed by interspecies interactions, or decreasing bighorn sheep susceptibility to pathogens. In developing biologic and therapeutic agents as tools, future research should focus not only on safety and efficacy of the products, but also on the potential for practical use in free-ranging populations.

The work group members recognize that this issue is controversial. Indeed, many of the recommendations found here were not reached via consensus but through majority opinion. This has been an important issue throughout the western United States. Several other working groups both at the state (e.g. Wyoming, 3) and national level (Western Association of Fish and Wildlife Agencies, 1) have convened working groups to address this issue. It is our hope that the list of options provided here will assist land and wildlife managers and permittees to reduce conflicts and minimize the risk of disease transmission.

References:

1. Western Association of Fish and Wildlife Agencies (WAFWA). 2007. Wild Sheep Working Group, Initial Subcommittee. Recommendations for Domestic Sheep and Goat Management in Wild Sheep Habitat, June 21, 2007. 27 pp. http://www.wafwa.org/documents/wswg/WSWGManagementofDomesticSheepandGoatsinWildSheepHabitatReport.pdf
2. Miller, M. W., Knowles, D. P., and M. S. Bulgin. 2008. Pasteurellosis Transmission Risks between Domestic and Wild Sheep. Council for Agricultural Science and Technology (CAST) August 2008. 8 pp.
3. Wyoming State-wide Bighorn/Domestic Sheep Interaction Working Group http://gf.state.wy.us/wildlife/sheep/index.asp