AUTHENTICATED
U.S. GOVERNMENT
INFORMATION
GPO

S. HRG. 116–191

EXAMINING THE IMPACTS OF DISEASES ON WILDLIFE CONSERVATION AND MANAGEMENT

HEARING

BEFORE THE

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

UNITED STATES SENATE

ONE HUNDRED SIXTEENTH CONGRESS

FIRST SESSION

OCTOBER 16, 2019

Printed for the use of the Committee on Environment and Public Works

Available via the World Wide Web: http://www.govinfo.gov

U.S. GOVERNMENT PUBLISHING OFFICE

40–418 PDF WASHINGTON : 2020

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

ONE HUNDRED SIXTEENTH CONGRESS

FIRST SESSION

JOHN BARRASSO, Wyoming, *Chairman*

JAMES M. INHOFE, Oklahoma
SHELLEY MOORE CAPITO, West Virginia
KEVIN CRAMER, North Dakota
MIKE BRAUN, Indiana
MIKE ROUNDS, South Dakota
DAN SULLIVAN, Alaska
JOHN BOOZMAN, Arkansas
ROGER WICKER, Mississippi
RICHARD SHELBY, Alabama
JONI ERNST, Iowa

THOMAS R. CARPER, Delaware, *Ranking Member*
BENJAMIN L. CARDIN, Maryland
BERNARD SANDERS, Vermont
SHELDON WHITEHOUSE, Rhode Island
JEFF MERKLEY, Oregon
KIRSTEN GILLIBRAND, New York
CORY A. BOOKER, New Jersey
EDWARD J. MARKEY, Massachusetts
TAMMY DUCKWORTH, Illinois
CHRIS VAN HOLLEN, Maryland

RICHARD M. RUSSELL, *Majority Staff Director*
MARY FRANCES REPKO, *Minority Staff Director*

C O N T E N T S

Page

OCTOBER 16, 2019

OPENING STATEMENTS

Barrasso, Hon. John, U.S. Senator from the State of Wyoming 1
Carper, Hon. Thomas R., U.S. Senator from the State of Delaware 3

WITNESSES

Guertin, Stephen D., Deputy Director for Program Management and Policy, U.S. Fish and Wildlife Service 6
Prepared statement 9
Responses to additional questions from:
Senator Barrasso 15
Senator Carper 17
Senator Markey 21
Cook, Walter E., Clinical Associate Professor, Veterinary Pathobiology, Texas A&M University 22
Prepared statement 24
Responses to additional questions from:
Senator Barrasso 31
Senator Carper 33
Niederriter, Holly, Environmental Scientist IV and Non-Game Mammal Biologist, Delaware Division of Fish and Wildlife, Department of Natural Resources and Environmental Control 35
Prepared statement 38
Responses to additional questions from Senator Carper 45

EXAMINING THE IMPACTS OF DISEASES ON WILDLIFE CONSERVATION AND MANAGEMENT

WEDNESDAY, OCTOBER 16, 2019

U.S. SENATE,
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS,
Washington, DC.

The Committee met, pursuant to notice, at 10:08 a.m. in room 406, Dirksen Senate Office Building, Hon. John Barrasso (Chairman of the committee) presiding.

Present: Senators Barrasso, Carper, Braun, Rounds, Sullivan, Boozman, Ernst, Cardin, and Gillibrand.

OPENING STATEMENT OF HON. JOHN BARRASSO, U.S. SENATOR FROM THE STATE OF WYOMING

Senator BARRASSO. Good morning. I call this hearing to order.

Today, this committee will examine the impacts of disease on our wildlife health, human health, and on the economy. We will explore what Government can do to combat the growing problem that we are facing.

Successful wildlife conservation and management depends on keeping wildlife populations healthy. Unlike in captive animals, disease in wildlife is often difficult to prevent, to detect, and to control. In many cases, disease hosted in infected wildlife can be transmitted to other wildlife, domesticated animals, and even to humans.

Diseases that spread from wildlife to humans pose an imminent threat in public health. Eastern equine encephalitis, also known as the Triple E, is a virus that can cause human brain infections, neurological problems, and even death. Triple E is naturally hosted in birds and can be transmitted to people through the bite of an infected mosquito.

In 2019, 31 cases of Triple E infections have been reported to the Centers for Disease Control and Prevention. That is an alarming 300 percent increase over the previous 10 year average. Triple E has already claimed 11 lives across the United States this year alone.

West Nile virus is hosted in birds, transmitted to people through the bite of an infected mosquito. An average of 2,500 people are infected with West Nile virus annually, including roughly 40 people in my home State of Wyoming.

Lyme disease is hosted in birds and mammals like deer and mice. It is transmitted to people through the bite of an infected

tick. An average of 33,000 people annually are reported to be infected with Lyme disease.

According to the Centers for Disease Control and Prevention, scientists estimate that more than six out of every ten known infectious diseases in people are spread from animals. Three out of every four new or emerging infectious diseases in people are spread from animals. Every year, tens of thousands of Americans will get sick from harmful germs spread between animals and people.

Disease can also spread from wildlife to other wildlife, and to domesticated animals, eradicating populations, eroding economic value, and creating new threatened and endangered species. Earlier this year, the Atlantic magazine ran an article entitled The Worst Disease Ever Recorded. It was about a particularly deadly fungus known as Bd. Bd has led to the extinction of 90 different amphibian species, and the catastrophic population decline of over 124 other amphibian species.

White-nose syndrome has killed an estimated 7 million bats in the United States. Bats play an important role in ecosystems, including through insect control. Largely because of white-nose syndrome, the U.S. Fish and Wildlife Service has listed the northern long-eared bat as a threatened species under the Endangered Species Act.

In Wyoming, the three diseases that pose the biggest threat to wildlife are chronic wasting disease, or CWD; pneumonia among bighorn sheep; and brucellosis. Chronic wasting disease affects deer, elk, and moose in our State, causing the degradation of the animal's brain, loss of bodily control, and death. It not only impacts Wyoming's management of these species, but also the operation of everything from landfills to feed grounds. Hunters have been advised not to eat meat from animals that they harvest if they test positive for chronic wasting disease.

Chronic wasting disease has been found in 277 counties in 24 States.

Brucellosis afflicts primarily Rocky Mountain elk and bison in the northwestern part of Wyoming. From a management perspective, transmission of brucellosis between elk or bison and domestic cattle is a serious concern. The bacterial disease is known to cause severe complications with the pregnancies of infected cows, resulting in economic losses for ranchers.

Also of concern is pneumonia, which has devastated Wyoming's herds of bighorn sheep.

Many entities are responsible for managing wildlife disease. States are the primary manager of wildlife within their respective borders, and usually they play the most important role in fighting wildlife disease.

Agencies throughout the Federal Government also manage wildlife disease. The U.S. Fish and Wildlife Service is the primary national wildlife management agency. But it is not alone. Other agencies within the Department of the Interior, along with the National Oceanic and Atmospheric Administration, the Department of Agriculture, and the Centers for Disease Control and Prevention, all have important roles.

With so many Federal and State players involved, coordination is clearly a key ingredient to improving the response to, and the

management of, wildlife-borne disease. So I look forward to hearing from our distinguished panel today on how the Federal Government can improve the effectiveness of its response to wildlife disease.

I would now like to turn to the Ranking Member, Senator Carper, for his opening remarks.

OPENING STATEMENT OF HON. THOMAS R. CARPER, U.S. SENATOR FROM THE STATE OF DELAWARE

Senator CARPER. Thanks, Mr. Chairman. Thanks so much for bringing us together today.

I had a chance to talk with each of our witnesses before we began the hearing, and I would say to our Deputy Director, thank you for all your service. He served, I think 40 years, did you say 40 years of service to the people of this country? And a number of those years as a Marine. So I can say, the Navy salutes the Marine Corps, and thank you for your service. Different uniforms, same team. There we go.

He is also an Aggie, right. You are not an Aggie from Texas, right?

Mr. GUERTIN. No, sir, Norwich University in Vermont.

Senator CARPER. There you go. All right.

Dr. Cook, great to see you. Thank you for joining us today.

And Holly, I will get to give a little introduction of you here in a few minutes. We appreciate your presence and your testimony.

Over the past couple of decades, wildlife diseases have spread rapidly across the United States. We feel it in Delaware and throughout DelMarVa. These diseases oftentimes have far reaching impacts on our ecosystems, human health, and the economy, and they present significant challenges for wildlife managers.

In Delaware, we have seen the devastating effects that disease can have on our wildlife, that includes amphibians, and on birds, and on bats. Since its discovery in New York in 2007, white-nose syndrome, which the Chairman has alluded to, has killed more than 6 million bats and spread to, I am told, 33 States.

In Delaware, white-nose syndrome has wiped out entire populations of State-endangered little brown bats, which provide an important ecosystem service to our farmers, and for a little State, we have a lot of them. The service provided by those bats is pest control. In fact, one study estimated that the economic value of bats to agriculture tops $3.7 billion annually, and that is a conservative estimate. That is about half of the value of the agricultural economy in our State, in years I recall.

Our country is also grappling with the wildlife diseases that mosquitos and ticks transmit to humans and to wildlife. West Nile virus, eastern equine encephalitis—did you call it Triple E? Triple E, and Lyme are all diseases that these pesky insects transmit to wildlife, to livestock, and to humans, with sometimes devastating impacts on our economy and on human health.

Because these diseases cross State and jurisdictional boundaries, addressing wildlife disease is a challenge that requires cooperation and collaboration—two of my favorite C words, cooperation and collaboration—between many parties in order to get us to consensus. We look forward to hearing from our expert witnesses about exam-

ples of partnerships between Federal agencies, States, tribes, and other parties to address wildlife diseases, such as the White-Nose Syndrome Response Team.

I also am interested to hear more today about how our Nation's wildlife scientists and managers, at both the State and Federal level, are working together to address the spread of wildlife disease. I would encourage our witnesses to identify areas of opportunity for expanded research and innovative management actions.

In considering solutions to prevent the further spread of wildlife disease, however, we would be remiss to overlook the fundamental drivers of this problem, including climate change and habitat loss. We know that temperature, rainfall, and humidity affect the abundance and spread of diseases, and we are seeing these impacts firsthand in the First State.

With warmer and wetter weather, new mosquito species, such as the Asian tiger mosquito, are taking residence in the First State.

Mosquito season is also growing longer, I am told. In Wilmington, where my wife and I live, our mosquito season now averages about 142 days long, and it was only about in the 1980s, about 30 years ago, that season was 117 days long. So as a result, we have seen an increase in cases of mosquito-borne diseases among wildlife, among livestock, and Delawareans.

What's more, change in human land use is causing declines in biodiversity, making species more vulnerable to emerging diseases by causing habitat loss, degradation, and fragmentation. So when we talk about wildlife disease, we must also consider how our Nation's extinction crisis is impacting its spread.

I would also note just briefly that this wide range of challenges magnifies the need for strong leadership at the agencies charged with managing wildlife. We thank you, Mr. Guertin, for providing that leadership today.

During our committee's business meeting just a couple of weeks ago, I expressed concern about the Administration's nominee to lead the U.S. Fish and Wildlife Service, due in part to her reluctance to fully disclose information about her previous employment and experience at the Department of Interior to this committee. Unfortunately, those concerns remain largely unaddressed today.

I would just end with this: by working together and taking a science based, holistic approach, I believe we can develop smart solutions that address both the root causes and the symptoms of wildlife diseases.

Again, Mr. Chairman, thanks for bringing us together.

We look forward to hearing from all of you.

Thank you.

Senator BARRASSO. Well, thank you very much, Senator Carper.

Before we proceed to hear from our witnesses, I would like to introduce Dr. Walter Cook, who currently serves as the Clinical Associate Professor of Veterinary Pathobiology at Texas A&M University, and a Veterinary Corps officer in the U.S. Army Reserves. Dr. Cook's distinguished career includes at least 20 years of service in Wyoming addressing the threat of wildlife disease, and we are very grateful for that service.

His experience in Wyoming includes brucellosis coordinator at the University of Wyoming's College of Agriculture, State Veteri-

narian for the Wyoming Livestock Board, Wildlife Veterinarian for the Wyoming Game and Fish Department, Regional Veterinary Coordinator for the Wyoming Department of Health, and the large animal veterinarian at Tri-State Large Animal Hospital in Cheyenne, Wyoming.

He has served as an adjunct assistant professor in the University of Wyoming's Veterinary Science Department and Lecturer at Laramie County Community College. Additionally, for 7 years, he served as an instructor for the National Center for Biological Research and Training at Louisiana State University.

Dr. Cook's success should come as no surprise, given he received his Ph.D. in wildlife epidemiology from the University of Wyoming in 1999.

Dr. Cook, it is a privilege to welcome you as a witness today before this committee. We want to thank you for traveling to Washington.

Before turning to the witnesses, I know, Senator Carper, you would also like to make an introduction.

Senator CARPER. Thank you.

Dr. Cook, I didn't realize you were Army. So a special privilege to welcome to you.

Mr. Chairman, I am grateful for the opportunity to introduce one of our witnesses, Holly Niederriter. Holly has worked for the State of Delaware for nearly 20 years. I think she told me she has lived in five States. But she chose to live for 20 years in a State whose tree is named after her, the holly tree. We have a special fondness for her as a result.

Throughout her time at Delaware's Department of Natural Resources and Environmental Control—well, sitting right behind me is our former secretary of that department, right behind me, Christophe Tulou, Christophe, raise your hand. Christophe was Secretary of the Department, and when he was going out the door, Holly walked in the other door and joined our State in that department.

Holly has worked with a wide array of species, I am told, including bats, beach nesting birds—we have several of those—ospreys, turtles, snakes, salamanders, and frogs. She currently oversees Delaware's bat program and Delaware's implementation of the Delmarva fox squirrel conservation plan, which has been a real success.

Holly has worked with other States and regional efforts as well as with the Fish and Wildlife Service, which would include Maryland, New Jersey, Pennsylvania, and one more.

I am trying to think of the States you have either worked in or lived in.

Ms. NIEDERRITER. Maryland, New York; did you say New York?

Senator CARPER. I did not.

Ms. NIEDERRITER. And New York.

Senator CARPER. OK, thanks. Well, we especially thank you for Delaware, the First State, for making us your last stop. We hope it is your last stop for a long time.

Thanks, Holly, and thanks for being with us today.

Again, we are delighted that you are all here. Welcome, one and all.

Thank you.

Senator BARRASSO. Thank you very much, Senator Carper.

We welcome all.

We will hear from three witnesses today. The first will be Dr. Stephen Guertin, who is the Deputy Director of the U.S. Fish and Wildlife Service at the Department of Interior. Then Dr. Walter E. Cook, Clinical Associate Professor of Veterinary Pathobiology, Texas A&M. And then Holly Niederriter, Wildlife Biologist, Delaware Department of Natural Resources and Environmental Control.

I would like to remind the three of you that your full written testimony will be made part of the official record of the hearing today. But we please ask you to keep your statements to 5 minutes so that we will have time for questions. We look forward to hearing your testimony.

Mr. Guertin.

STATEMENT OF STEPHEN D. GUERTIN, DEPUTY DIRECTOR FOR PROGRAM MANAGEMENT AND POLICY, U.S. FISH AND WILDLIFE SERVICE

Mr. GUERTIN. Good morning, Chairman Barrasso, Ranking Member Carper, and members of the committee. Thank you for the opportunity to discuss wildlife disease and the challenges it poses to wildlife conservation and management.

Wildlife disease is a complex and dynamic issue that presents an enormous challenge to the Fish and Wildlife Service in our work to conserve wildlife for current and future generations of Americans. My written testimony catalogs the large number of diseases that affect wildlife and present serious management challenges to the Service and our partners.

My written testimony also describes in greater detail our management response to these challenges. These include diseases like chronic wasting disease in deer, elk, and moose; white-nose syndrome in hibernating bats; and others. I will speak more about those in a moment.

In the last 50 years, there has been a steady increase in wildlife mortality caused by infectious diseases. The effect of disease on wildlife not only includes the death of individuals, but the weakening of resilience to other environmental stressors, and ultimately can mean the collapse of entire populations. When combined with other stressors, diseases can also necessitate increased species protections.

How does the Service address such a daunting challenge? We can't do it alone, and I cannot emphasize enough that our most important partners in this effort to address wildlife disease are our colleagues in the State fish and wildlife agencies. Partnering with States is key for the Service to be able to address these multi-jurisdictional challenges, and our seamless relationship with the Association of Fish and Wildlife Agencies is a great example of this partnership and our shared goal of combating wildlife disease.

The impacts of wildlife disease on species are also a threat to the economy. Pollinator species like bats and bees are invaluable to agriculture. Wildlife associated recreation like hunting, angling, and

wildlife watching generated $170 billion in total expenditures in 2016, the most recent data.

Wildlife diseases also impact the domestic animals that serve as food resources and as our companions. In addition, the majority of emerging animal diseases that are transmissible to humans originate in wildlife species.

To address this dynamic nature of wildlife disease, the Service houses several nationwide programs that plan for and help respond to wildlife diseases, including our Wildlife Health Office, Aquatic Animal Health Program, and our White-Nose Syndrome Program.

I would now like to talk more about our efforts to address two serious and prominent disease threats: white-nose syndrome and chronic wasting disease. White-nose syndrome, or WNS, is a fungal disease affecting hibernating bats that is estimated to have killed more than 6 million bats in the U.S. and Canada alone. The fungus responsible for this disease has now spread to 38 U.S. States and 7 Canadian provinces. Twelve hibernating bat species, including two endangered and one threatened species, have been confirmed with WNS in the United States.

Through annual appropriations language, Congress designated the Service as the lead agency to manage the national response to WNS, working with Federal, State, tribal, and international partners. Since 2008, the Service has been coordinating the response to this disease and leading the implementation of a national multi-agency response plan. To date, we have awarded over $35 million to researchers and State agencies to contain the spread of WNS and develop tools to increase the survival of affected bat species.

In the past decade, the WNS response community has made extraordinary progress to understand the disease and to develop tools to study and reduce the devastating effects on bats in North America.

Chronic wasting disease is a contagious, fatal disease that is becoming more prevalent in wild North American cervid populations, such as deer, elk, and moose. Unfortunately, there is no known treatment or cure for CWD. Therefore, prevention of the disease and limiting its spread is essential.

To date, there have been no reported cases of CWD interaction or infection in people, but research on this subject is ongoing. Currently, 48 national wildlife refuges, 24 waterfowl production areas, and 8 fish hatcheries are located in counties already affected by CWD. We are working to ensure that activities on Service managed lands and the larger DOI portfolio are focused on preventing the further spread of CWD and minimizing the impacts on already affected populations.

A high level of collaboration between Federal and State agencies, tribes, NGOs, and academia is needed to address the growing threat of CWD. States are the ultimate leaders for CWD, but the Department can contribute significantly by supporting the States and taking prudent actions on lands managed by the Department. We have a number of initiatives, including those led by our Wildlife Health Office.

In conclusion, the many challenges posed by wildlife diseases are diverse in their nature and inevitably present surprises. We will continue to work closely with our partners at home and abroad to

address these challenges, because wildlife diseases do not respect political boundaries and threaten every corner of the country.

Thank you, Mr. Chairman, Senator Carper, for your leadership in convening this hearing. We look forward to answering your questions as best we can.

[The prepared statement of Mr. Guertin follows:]

Testimony of Stephen Guertin
Deputy Director for Policy
U.S. Fish and Wildlife Service, Department of the Interior
before the
Senate Committee on Environment and Public Works
regarding
"Examining the Impacts of Disease on Wildlife Conservation and Management"

October 16, 2019

Good morning Chairman Barrasso, Ranking Member Carper, and members of the Committee. I am Stephen Guertin, Deputy Director for Policy for the U.S. Fish and Wildlife Service (Service) within the Department of the Interior (Department). Thank you for the opportunity to discuss wildlife disease and the challenges it poses to wildlife conservation and management. My testimony will focus on the Service's role in addressing wildlife disease, as well as the role our various programs play.

Introduction to Wildlife Health and Disease

The Service's mission is working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people. Wildlife disease presents multifaceted and dynamic challenges to fulfilling that mission. Partnering with states is key for the Service to be able to address these multi-jurisdictional challenges, and our seamless relationship with the Association of Fish and Wildlife Agencies is a great example of this partnership and our shared goal of combating wildlife disease with the states.

In the last fifty years, there has been a steady increase in wildlife mortality caused by infectious diseases. When combined with other stressors, diseases in wildlife can result in serious conservation challenges for wildlife management agencies and necessitate increased species protections. Beyond conservation concerns, the impacts of wildlife disease on species are a clear and present danger to the economy. Wildlife associated recreation like hunting, angling, and wildlife watching generated $156.9 billion in total expenditures in 2016 (most recent data). Pollinator species like bats and bees are critical to agriculture. Wildlife diseases also impact the domestic animals that serve as a food resource and as our companions. In addition, the majority of animal diseases that are transmissible to humans originate in wildlife species.

Diseases that are impacting wildlife populations, as well as negatively affecting human and domestic animal health in the United States, include: chronic wasting disease in deer, elk, and moose; white-nose syndrome in hibernating bats; West Nile virus, botulism, avian cholera, and avian malaria in birds; ranaviruses and fungal diseases in amphibians and reptiles; rabies and plague in mesomammals; and harmful algal blooms in fresh and saltwater ecosystems affecting a variety of species. The United States is also under constant threat from foreign animal diseases such as highly pathogenic avian influenza, New World screwworm, cattle fever carried by cattle fever ticks, African swine fever, foot and mouth disease, Rift Valley fever, and Ebola hemorrhagic fever. Driving the emergence and impacts of these diseases are a number of factors

including invasive species, the wildlife trade (both legal and illegal), feeding of wildlife, land-use changes, and increased contact between humans, domestic animals, and wildlife.

As stewards of wildlife, the Service and our partners implement strategies to prevent the introduction of disease into susceptible populations and to respond to and manage wildlife diseases if they become established. Wildlife disease issues and their solutions vary greatly across the country, and within the National Wildlife Refuge and Hatchery Systems. Disease outbreak locations are shifting and spreading over time in response to changes in land use and climatic conditions. To address the dynamic nature of wildlife disease, the Service houses several nationwide programs that plan for and help respond to wildlife disease issues including the Wildlife Health Office, the Aquatic Animal Health Program, and the white-nose syndrome program, as well as the global programs of the Service's International Affairs program and the Office of Law Enforcement.

The success of this work is dependent on the Service's collaboration with many partners, including: State wildlife management agencies and the Association of Fish and Wildlife Agencies; Southeastern Cooperative Wildlife Disease Study; Universities; Non-Governmental Organizations; U.S. Department of Agriculture-Animal and Plant Health Inspection Service (USDA-APHIS)-Wildlife Services; Department of Commerce-National Oceanic and Atmospheric Administration (DOC-NOAA); National Park Service; and the U.S. Geological Survey (USGS) National Wildlife Health Center. In addition to our conservation partners, the Service also works closely with human and animal health experts at the Centers for Disease Control and Prevention, U.S. Agency for International Development (USAID), U.S. State Department and county public health departments, state agricultural agencies, and USDA-APHIS-Veterinary Services.

Disease Prevention, Management, and Emergency Response

Disease prevention is far more effective and less costly than disease control. Diseases can be a normal, balanced component of the natural world, but they can also be a red flag that a wildlife population has lost its resilience due to stressors such as habitat loss, genetic bottlenecks, invasive species, a lack of biodiversity, failures in land management, or poor water quality and quantity. The Service applies specific conservation practices that are key to disease prevention in order to protect and restore resilient ecosystems and wildlife populations, which are then able to better withstand disease impacts and return to pre-disease abundance and health. These conservation practices work to achieve intact and diverse ecosystems, as well as connectivity between wildlife habitats and populations. Connected landscapes in the United States that are under these types of conservation protections help to provide a buffer to the increasing stressors on wildlife health.

Other preventive measures to decrease the spread of disease include reducing activities that unnaturally congregate animals into small geographic areas (e.g., feeding, baiting, and scent lures); restricting wildlife rehabilitation and release practices; curtailing wildlife translocations; reducing interactions between humans, domestic animals, and wildlife; limiting captive propagation of wildlife; and restoring natural water quality, quantity, and flow to landscapes. In some cases, once a new wildlife disease has been introduced to a wildlife population, eradication is not possible.

Once wildlife illness and mortalities are detected in wildlife populations, disease contingency plans, wildlife disease surveillance, investigation of mortality events, and appropriate disease management strategies are vital components of an effective response. The Service works closely with wildlife disease diagnostic laboratories throughout the United States including the USGS National Wildlife Health Center, the Southeastern Cooperative Wildlife Disease Study, and university and state-run diagnostic laboratories to conduct cause-of-death analyses for wildlife species found sick or dead, and to make management recommendations for the prevention of future cases where possible.

While many wildlife disease events are predictable and can be planned for, some outbreaks (such as foreign and emergency animal diseases) are unexpected, fast-moving, and require an emergency response with a full multi-agency incident command structure. Preparation for these events, both through training and acquisition of the necessary tools for response, is extremely important. The Service works closely with the Department's Office of Emergency Management to ensure that personnel obtain the appropriate emergency response certifications and wildlife disease training.

The Service's Work on Wildlife Diseases

The Service has been on the front lines addressing wildlife disease and has multiple active programs that perform collaborative work across the country to combat specific wildlife diseases. Those diseases and programs include leading efforts to combat white-nose syndrome, New World screwworm, chronic wasting disease, harmful algal blooms, bison disease, cattle fever tick, fish disease, and wildlife-to-human transmitted disease.

White-nose Syndrome Response

White-nose syndrome (WNS) is a fungal disease affecting hibernating bats that is estimated to have killed more than 6 million bats in the United States and Canada alone. The fungus responsible for this disease has now spread to 38 U.S. states and seven Canadian Provinces. Twelve hibernating bat species, including two endangered and one threatened species, have been confirmed with WNS in the United States.

Through annual appropriations language, Congress designated the Service as the lead agency to manage the national response to WNS, working with federal, state, tribal, and international partners. Since 2008, the Service has been coordinating the response to this disease and leading the implementation of a national multi-agency response plan. To date, the Service has awarded over $35 million to researchers and state agencies to contain the spread of WNS and develop tools to increase the survival of affected bat species.

In the past decade, the WNS response community has made extraordinary progress to understand the disease and develop tools to study and reduce the devastating effects of WNS on bats in North America. Several experimental management tools for WNS are in various stages of testing. These include: a fungal vaccine; biologically derived compounds or use of UV light to kill or inhibit growth of the fungus; living microbes or viruses that may provide mechanisms for bats to resist or avoid infection; and manipulation of temperature and humidity in winter roosts to reduce infection severity. The North American Bat Monitoring Program (NABat) is another

important product of the national response to WNS. NABat is the first program to establish standardized monitoring protocols for bats across the continent and the infrastructure needed to understand population trends for several important bat species affected by WNS and other stressors.

Disease Response in the Refuge System

The National Wildlife Refuge System's Wildlife Health Office supports the Service's work on wildlife disease by conducting surveillance, emergency response, on-site animal disease training, and research to determine the health impacts of environmental changes on wild populations. The office delivers consistent, high-quality, wildlife health services to the Refuge System and other Service programs.

Examples of the work and diseases tackled by the Wildlife Health Office include: deploying veterinary staff to the National Key Deer Refuge during the New World screwworm outbreak emergency response in the Florida Keys in 2016-2017, and providing harmful algal bloom response, test kits, diagnostics, and technical recommendations. The office also led on guidance for the Service's bison conservation program and providing bison disease surveillance, low-stress handling training, and genetic diversity testing. Finally, the Wildlife Health Office spearheaded the development of several wildlife health-oriented emergency management positions to provide integrated support during all-hazards emergencies.

Cattle Fever Tick

One example of this work is the Service's response to the cattle fever tick, which once ranged from Texas to Virginia. Cattle fever ticks are vectors for *Babesia spp.*, a protozoa that causes cattle fever, which ultimately results in cattle deaths. In February 2018, the Service, USDA-APHIS, and the Texas Animal Health Commission (TAHC) cooperated in finalizing an Environmental Assessment on cattle fever tick eradication to assist in the control of this invasive species. The debate about how to control fever ticks, prevalent from 2014-2017, has subsided after the agreed upon control techniques were established by the Service and USDA-APHIS/TAHC.

In early 2018, fever tick control agencies formally requested national wildlife refuge Special Use Permits for the use of Ivermectin-laced corn on Service-managed lands as a method to kill fever ticks, which die after feeding on ungulates that have eaten the Ivermectin-laced corn. After approval by the Service, Ivermectin-laced corn feeders were installed and are still in operation at Laguna Atascosa National Wildlife Refuge and Lower Rio Grande Valley National Wildlife Refuge. Currently, Laguna Atascosa is seeing a decrease in cattle fever tick numbers based on inspection of harvested ungulates during public hunts.

Chronic Wasting Disease

The Service's Wildlife Office has also played an important supporting role responding to chronic wasting disease (CWD). CWD is a contagious, fatal disease that is becoming more prevalent in wild North American cervid populations, such as deer, elk, and moose. Unfortunately, there is no known treatment or cure for CWD and eradication of the disease from free-ranging cervids is not a realistic objective. Therefore, prevention of the disease and limiting its spread is essential. To

date, there have been no reported cases of CWD infection in people but research on this topic is ongoing.

Currently, 49 National Wildlife Refuges, 24 Waterfowl Production Areas, and 8 Fish Hatcheries are located in counties already affected by CWD. The Service is working with state fish and wildlife agencies to ensure that activities on Service-managed lands are focused on preventing the further spread of CWD and minimizing the impacts of CWD on already-affected populations.

A high level of collaboration between federal and state agencies, tribes, non-governmental organizations, and academia is needed to address the growing threat of CWD. States are the ultimate leaders for CWD, but the Department can contribute significantly to managing the disease by supporting states, other stakeholders, and taking prudent actions on lands managed by the Department's agencies. Since 2004, the Service has supported state-led CWD management through the Wildlife Health Office. The office funds CWD work on state and Service lands and provides training on CWD sample collection to state and federal personnel. The Wildlife Health Office also collects and tests samples for CWD in direct support of state activities, and works with states to develop collaborative plans that include CWD management and monitoring strategies.

Aquatic Animal Drug Approval Partnership

The Service's Aquatic Animal Drug Approval Partnership (AADAP) program is the only program in the United States singularly dedicated to obtaining U.S. Food and Drug Administration (FDA) approval for new medications needed to combat disease in fish culture and for fisheries management. Since the late 1990's, working with other federal agencies, Native American tribes, state agencies, universities, and private partners, AADAP has contributed to virtually every new fish medication approved by the FDA. The program allows fisheries professionals to more effectively rear and manage a variety of fish species. Aquatic animal health biologists working at the Service's six Fish Health Centers detect, monitor, and mitigate disease-causing pathogens that threaten aquatic species across the nation. Their findings inform management decisions that improve the health of captive-reared fish both at hatcheries and among fish populations in the wild. Service fish health professionals also investigate emerging aquatic animal health issues, such as invasive species that can be vectors for disease, to help prevent the introduction and spread of aquatic pathogens.

Through AADAP, the Service provides research that facilitates the approval of critically important drugs for federal, state, tribal, and private hatcheries that have saved 40 million freshwater fish each year for restoration, recovery, and recreation. This work is essential in ensuring: (1) the efficient and effective propagation at fish hatcheries across the nation; (2) that the introduction of hatchery fish to streams, lakes and rivers does not introduce disease to native wild populations; and, (3) robust populations of fish for recreational anglers, who contribute $46 billion to the national economy each year.

Aquatic Invasive Species

Adverse impacts from invasive species are among the most significant challenges facing the conservation of native fish and wildlife populations and can be an expensive burden for public and private sectors alike. The Service relies on Title 18 of the Lacey Act (18 U.S.C. § 42(a)(1))

to prohibit the importation and transport of injurious species across international, U.S. territorial, and limited state, lines, to prevent the introduction, establishment and spread of harmful invasive species. While Title 18 does not allow the Service to designate pathogens such as viruses, bacteria, and fungi that cause disease as "injurious wildlife", the host organisms may qualify for such a listing.

In 2016, the Service listed 201 species of salamanders as injurious wildlife (50 CFR §16.14) because of their capacity to carry salamander chytrid fungus and serve as the vector for this fungus to enter into U.S. ecosystems. In addition, live or dead (uneviscerated) fish from the salmon family are prohibited entry into the United States for any purpose except by direct shipment containing the requisite health certificate noting testing for the *Oncorhynchus masou* Virus, Viral Hemorrhagic Septicemia Virus, Infectious Hematopoietic Necrosis Virus, and Infectious Pancreatic Necrosis Virus (50 CFR §16.13). This listing became effective in 1968 to mitigate the risks posed to wild fisheries of the United States from these harmful pathogens being imported with salmonid fish.

Future Challenges

The Service and its partners will continue to face complex wildlife disease challenges in the future. Two of those new challenges are carcass management and chemical immobilization of wildlife. There is a decreasing willingness of municipal solid waste landfills to accept animal carcasses potentially infected with CWD. This places pressure on state and federal wildlife management agencies to find safe, alternative means of carcass disposal that fit within their budgets, which is a difficult task considering the fast pace spread of CWD. There has also been a tightening of restrictions on veterinary controlled substances for the chemical immobilization of wildlife due, in part, to the opioid crisis. This has drastically reduced the Service's ability to conduct field work such as placing radio and GPS collars on animals for the monitoring of migration patterns and behaviors as they relate to wildlife diseases.

Conclusion

The many challenges posed by wildlife disease are diverse in their nature and inevitably present surprises. The Service will continue to work closely with our partners at home and abroad to address these challenges together, because wildlife diseases do not respect political boundaries and threaten every corner of our country. The Service thanks the Committee for its interest in this critically important aspect of environmental conservation and management.

Committee on Environment and Public Works
Impacts of Diseases on Wildlife Conservation and Management
October 16, 2019

Questions from Chairman Barrasso

Question 1: More than 10 years ago, the U.S. Fish and Wildlife Service issued a recommendation to limit cave activity that could result in the spread of white-nose syndrome. Since that time, how has the Service adjusted its recommendations and policies to promote containment of white-nose syndrome, including with regard to its issuance in 2016?

Response: In March 2009, the U.S. Fish and Wildlife Service (Service), in coordination with other federal and state agencies in the Eastern U.S., issued a Cave Advisory recommending a voluntary moratorium on caving activity and restrictions on the transportation of clothing and equipment between locations to prevent the human-assisted spread of the fungus that causes white-nose syndrome (WNS). These recommendations followed the "universal precautions" principle to reduce the spread of infectious diseases. The Cave Advisory was reviewed frequently as more information became available and was maintained through 2015.

In 2016, the Service issued a revision of the 2009 Cave Advisory, entitled "Recommendations for Managing Access to Subterranean Bat Roosts". The 2016 document is the product of the collaborative national response to WNS, with contributions from representatives of key stakeholder groups, researchers, and natural resource management agencies, and it has the endorsement of the national, multi-agency WNS oversight committees. These recommendations use the latest scientific evidence to justify actions intended to reduce the risk of people unintentionally moving the fungus between roost sites and of disturbing vulnerable bats at those sites, while also considering potential impacts to scientific, educational, and recreational opportunities.

In addition to the 2016 recommendations, in November 2019, the Service released another national response document entitled "White-nose Syndrome Show Cave Guidance", for managers of private and public cave sites operated for tourism and recreation. This guidance document provides examples of how site operators can contribute to containment efforts in ways that are compatible with the operational objectives at their locations.

Finally, we continue to maintain and regularly revise the "National Decontamination Protocol for White-nose Syndrome". This core protocol provides a geographic framework for adherence to containment measures and describes methods for cleaning and disinfecting equipment and clothing using laboratory-tested products to reduce the risk of spreading the fungus after visiting caves or working with bats.

All of these documents are revisited regularly as new information becomes available or circumstances change, and are available on our WNS public website at whitenosesyndrome.org.

Committee on Environment and Public Works
Impacts of Diseases on Wildlife Conservation and Management
October 16, 2019

Question 2: At the federal level, the U.S. Fish and Wildlife Service is responsible for managing wildlife, including wildlife that is listed as threatened or endangered under the Endangered Species Act, and wildlife on refuges and lands that it manages. How does the Service balance the need to develop strong, "universal" Service-wide policies that ensure adherence with best practices in wildlife management with an appropriate recognition of and respect for the primacy of states?

Response: The Service is committed to being a good partner to the States. In 2018, Secretary Zinke issued a Memorandum to all Bureaus reaffirming the authority of the States to exercise their legal authority to regulate fish and wildlife species on Federal public lands and waters, except as otherwise required by Federal law. We recognize that States are good stewards of our natural resources and practice sound management of fish and wildlife while allowing appropriate opportunities for citizens to enjoy public resources.

Committee on Environment and Public Works
Impacts of Diseases on Wildlife Conservation and Management
October 16, 2019

Questions from Sen. Carper:

Question 3: In addition to habitat loss and climate change, wildlife trade is a major driver of wildlife disease. International trade in wildlife and wildlife parts - both legal and illegal – can introduce diseases to susceptible native wildlife populations. The U.S. Fish and Wildlife Service's Office of Law Enforcement plays a major role in enforcing wildlife trade regulations.

a. **Considering the vast number of wildlife and wildlife parts imported into the United States each year, would you share what you know about the different pathways by which diseases can be transmitted through trade?**

Response: Trade in wildlife and wildlife parts, both domestically and through importation into the U.S., poses a risk of introduction of pathogens that can have implications for domestic wildlife populations, animal agriculture, and human health. Disease transmission may occur through a number of routes or pathways and is dependent on characteristics of the pathogen (e.g. the type of bacteria or virus), as well as the product responsible for the transmission (e.g. live animals versus wildlife parts).

Trade in live wildlife presents the highest risk of introduction of wildlife diseases into the U.S. Diseases that pose a significant threat to native wildlife include brucellosis, tuberculosis, classical and African swine fever, and foot-and-mouth disease. These and other diseases can also pose a threat to U.S. agriculture. The domestic trade in native wildlife also poses a significant risk of disease spread to wildlife within the U.S. Examples include chronic wasting disease in deer and elk, and the chytrid fungus, which is currently devastating amphibian populations.

Disease transmission from wildlife to humans may occur through direct contact with wildlife, including those imported for the pet trade, zoological display, education, or laboratory use. Examples include monkeypox from rodents imported as pets, as well as a variety of potential disease exposures from nonhuman primates imported for science, exhibition, or education. Examples of diseases of concern with nonhuman primates include Herpes B, hemorrhagic disease viruses, enteric disease viruses, or bacterial infections.

b. **What are the major challenges the Office of Law Enforcement faces in preventing the introduction of exotic diseases through wildlife trade?**

Response: The Service, through its Office of Law Enforcement (OLE), has broad authority to inspect all wildlife imports, and assists Federal agencies that have the expertise and authority to identify and prevent the introduction of zoonotic and animal diseases. OLE Wildlife Inspectors regularly coordinate with the CDC on physical inspections of non-human primates, turtles and tortoises with shell lengths less than 4 inches, and bats – all of which are subject to CDC import restrictions based on human health concerns. Wildlife Inspectors also coordinate with USDA-Veterinary Services on wildlife imports that are prohibited due to livestock health issues, such as

hedgehogs that can transmit foot-and-mouth disease and tortoises carrying ticks infected with heartwater disease, and to quarantine exotic birds seized at our borders.

The U.S. wildlife trade has grown over the past decades, heightening concerns about species conservation, the introduction of injurious animals and plants, and potential risks to human health and domestic wildlife. In particular, the demand for live wildlife has escalated, driven in part by the increasing popularity of exotic pets in the U.S. In addition, the ease of travel, transport, and transaction (including e-commerce) has removed barriers to wildlife trade. Wildlife importers have access to ample financing, technology, and overnight air cargo shipping services from virtually any place in the world.

c. **Does Congress need to strengthen laws to prevent the introduction of exotic diseases? Please elaborate.**

Response: The Service relies on the Lacey Act (18 U.S.C. § 42(a)(1)) to regulate the importation and transport of species determined to be injurious to human beings, the interests of agriculture, horticulture or forestry, or to wildlife or wildlife resources. The Service historically interpreted the Lacey Act to include a prohibition on the transportation of injurious species between States within the continental United States. However, in 2017 the U.S. Court of Appeals for the D.C. Circuit held that 18 U.S.C. § 42(a)(1) does not prohibit transport of injurious wildlife between States within the continental United States. As a result, in the D.C. Circuit and any other circuits that adopt that interpretation of the statute, the prohibition on transport of injurious wildlife is not applicable when the transport occurs between States within the continental United States. Addressing the issues posed by this decision would need to be done legislatively.

Wildlife disease prevention is a collaboration with the other Federal agencies responsible for identifying possible health risks and wildlife disease. The CDC currently regulates the import of dogs, cats, turtles, snakes and lizards, monkeys, African rodents, and bats; and the USDA regulates non-domestic hoof stock, birds, and other specific mammals that originate in countries positive for reportable diseases. These species are regulated for specific diseases and thus may be approved entry if deemed safe.

Question 4: The public can play a major role in facilitating the spread of many wildlife diseases. For example, humans visiting caves can spread the fungus causing white-nose syndrome via contaminated clothing or equipment. People importing exotic frog species as pets can unintentionally cause the introduction of exotic diseases into native wildlife populations. Would you please elaborate on the role that public participation and education can play in minimizing the spread of wildlife disease? Is there anything Congress can do to improve opportunities for public education and engagement to reduce the spread of wildlife diseases?

Response: The need to adopt a collaborative and multidisciplinary approach to wildlife health surveillance is increasingly recognized and the general public can make a significant contribution to this work through citizen science. Public participation has enabled both federal and state

agencies to significantly increase their effectiveness in wildlife disease surveillance through observations, reporting, and biological sample collection. At the same time, public participation in scientific research has been demonstrated to advance the participants' environmental education and increase public engagement.

For wildlife diseases that may be spread or exacerbated by human behaviors, public education and engagement is crucial to effective prevention programs. However, prevention education is not easy and may require repetition, persistence, and patience. Human dimensions research supports this work by helping managers to understand the societal drivers and consequences of wildlife diseases and better communicate the necessity of reducing the spread of wildlife diseases to the public. Supporting educational and engagement opportunities along with human dimensions research to understand human drivers, knowledge, and attitudes around wildlife disease is critical to combating wildlife disease.

Question 5: From DNA technologies to novel vaccines, scientists and managers have proposed innovative technologies and methods to monitor and manage outbreaks of disease in wildlife populations. What role does innovative research and technology play in preventing or mitigating the diseases that you study or manage?

Response: Innovative research and development of new technologies are vital to effective wildlife disease detection, surveillance, and response activities. As a management agency, the Service supports and relies on the advanced wildlife disease research being conducted at a variety of institutions including the Southeastern Cooperative Wildlife Disease Study, Northeastern Wildlife Disease Cooperative, the USGS National Wildlife Health Center, USDA APHIS Wildlife Services, the U.S. Centers for Disease Control and Prevention, state wildlife management agency laboratories, and numerous universities both in the U.S. and abroad.
In order to prevent or mitigate wildlife diseases, we must first understand the cause of the disease (pathogen), affected species (host), and method of disease spread in the environment. Once that information has been established, we are able to develop diagnostic capabilities to detect the disease and begin to determine how it may be impacting wild populations. Consequently, we can begin to apply management techniques to break the cycle of transmission and prevent the spread of disease. None of this would be possible without the cutting-edge wildlife disease research and medical technology.

Question 6: There are numerous diseases plaguing our coastal and marine wildlife, including sea turtles, manatees, and sea otters. Disease is also a concern in freshwater ecosystems, where diseases such as whirling disease afflict salmon and trout. In these aquatic environments, disease containment and response initiatives across governance boundaries are challenging. How does the U.S. Fish and Wildlife Service collaborate with other federal, state, and local authorities in these situations? Which NGOs does the Service call upon to help with monitoring, response, restoration, outreach, and public education?

Response: The Service has responsibility under the Marine Mammal Protection Act (MMPA) for the conservation and management of manatees, sea otters, walruses, and polar bears within

waters of the United States. Monitoring the status and health of marine mammal populations, including disease vectors and environmental conditions, is important for their conservation and management. The Service accomplishes this responsibility through our cooperative partnerships with other Federal and State agencies, Natives Tribes, Aquaria, Universities, and other stakeholders. Many of these agencies and facilities also provide assistance in rescuing injured animals from the wild, rehabilitating these animals for release, studying the causes of injuries or deaths, collecting carcasses, conducting necropsies, and analyzing biological samples. The Service is currently in the process of developing a grant program under the MMPA that would provide Federal funds for our partners in these efforts. In addition, the Service engages with the Working Group on Marine Mammal Unusual Mortality Events (UMEs), established under the MMPA, when a UME is declared for species under our jurisdiction.

The Service also utilizes six certified Fish Health Centers to detect, monitor, and mitigate disease-causing pathogens that threaten aquatic species. Their findings inform decisions that improve the health of captive fish at both Federal and partner hatcheries and fish populations in the wild. To accomplish this, Service Fish Health Centers utilize National Wild Fish Health Survey funds to conduct analyses of fish provided by Service partners to ensure that fish moved from the wild onto production facilities or fish moved from production facilities into the wild are not a vector for disease. The results of disease testing are shared with our partners. While the Service does not rely on our NGO partners such as the American Fisheries Society, National Aquaculture Association, American Veterinary Medical Association, and the U.S Animal Health Association for assistance with monitoring, response, and restoration activities, their ability to reach a broad constituency plays an important role in providing outreach and education of emerging disease issues. In addition, the Service approves import requests for salmonids from foreign countries to ensure that they are free of four pathogens that could infect domestic fish.

Committee on Environment and Public Works
Impacts of Diseases on Wildlife Conservation and Management
October 16, 2019

Questions from Sen. Markey

Question 7: What is the federal response from the U.S. Fish and Wildlife Service to the outbreak of Eastern equine encephalitis (EEE) in Massachusetts? At least twelve cases have been reported this season in Massachusetts, with three deaths. This is a dramatic increase from the total often human cases between 2009 and 2018 in Massachusetts.

Response: The Service does not have a lead role in addressing Eastern equine encephalitis, which is transmitted by infected mosquitoes. The Centers for Disease Control and Prevention has a key role, as this is primarily a human health issue. Our agency does manage mosquito populations on National Wildlife Refuges and National Fish Hatcheries, in order to support efforts to control the mosquito population for human health impacts. In Massachusetts, two National Wildlife Refuges - Parker River and Monomoy - allow monitoring and control of mosquitoes on specific marsh areas that have high mosquito populations. We continue to allow local mosquito control agencies to conduct these activities through close coordination and to minimize harm to fish and wildlife.

Question 8: What federal resources are required to effectively respond to EEE in Massachusetts and ensure containment of this deadly disease? Are any resources limited that would prove critical in coordinating a rapid and successful response?

Response: As mentioned in the above response, the Service does not have a lead role in addressing Eastern equine encephalitis. The Service has adequate resources to manage mosquito populations on our lands.

Question 9: Lyme disease is one of the fastest growing infectious diseases in the U.S., partially due to increased average daily temperatures. In Massachusetts, the black-legged tick (Ixodes scapularis) is the most common vector for Lyme disease transmission and is carried via woodland rodents. What wildlife management activities are being done to reduce the risk of Lyme disease to humans and domestic animals?

Response: The Service does not have a lead role in addressing Lyme disease and wildlife impacts. The Centers for Disease Control and Prevention has a key role for the human health impacts and the National Institutes of Health is also studying this serious human health issue. We understand the seriousness of this issue, and in response we have posted signage in public locations to educate our visitors about the risks associated with Lyme disease and other tick-borne diseases and encourage visitors to take precautions to minimize the risk of transmission.

Senator BARRASSO. Thanks for that very thoughtful testimony. We are very grateful.

Dr. Cook.

STATEMENT OF WALTER E. COOK, CLINICAL ASSOCIATE PROFESSOR, VETERINARY PATHOBIOLOGY, TEXAS A&M UNIVERSITY

Mr. COOK. Good morning, Chairman Barrasso, Ranking Member Carper, members of the committee. Thank you for the opportunity to provide my perspective on disease challenges to wildlife management and conservation.

Today, I will highlight some of the lessons I have learned over the last 25 years dealing with wildlife diseases, and many of them have been mentioned already.

Chronic wasting disease is a prion disease that affects the cervid or deer family. Although related to bovine spongiform encephalopathy, it is a distinct disease. Prions are infectious proteins that convert normal proteins found in the brain into their abnormal prion form. Over time, microscopic holes appear, and changes in behavior and body condition develop, and ultimately result in death.

CWD can be transmitted to other cervids, directly via saliva, urine, or feces, or indirectly when the environment gets contaminated. Since this disease was first recognized 50 year ago, it has been reported in 24 States, 2 Canadian provinces, and several other countries.

Chronic wasting disease has caused declines in some populations in Colorado and Wyoming, but not in others. There is no evidence that CWD is a human health threat, or that it can be naturally transmitted to livestock, but concerns remain.

The public remains confused and concerned about chronic wasting disease. There is a lack of understanding about the potential impacts of the disease. There is a feeling among some interest groups that regulations are overly stringent. The fact that different States manage CWD differently also adds to this confusion. Finally, there is a multitude of different messages concerning CWD's impact to humans and animals.

Bighorn sheep respiratory disease complex was also previously mentioned by the Chairman. Bighorn sheep are extremely susceptible to respiratory pathogens. Huge outbreaks have occurred, in some cases eradicating entire populations. In a typical scenario there is a die off that affects large proportions of the population, then subsequently, that population fails to rebound because young animals fail to get recruited into the population, even though lambs are being born.

While clearly not absolute, there is an association with domestic sheep having close contact with bighorns prior to an outbreak. This has caused a great deal of contention between domestic sheep producers and wildlife managers and enthusiasts.

Wyoming resolved this conflict via the Wyoming statewide Bighorn/Domestic Sheep Interaction Working Group, which included representatives of State and Federal wildlife and livestock agencies, producers groups, wildlife non-governmental organizations,

and enthusiasts. By working from a set of common ground rules and common goals, the group became very effective.

White-nose syndrome of bats is a fungus that was first detected in New York, and the disease remains most common in the northeast and mid-Atlantic States. It kills by invading the skin of hibernating bats and leads to emaciation, which causes the bats to wake from hibernation early in the year and subsequently succumb to starvation, cold exposure, or both.

The fungus for white-nose grows well in cold, dark environments, the type of environments that bats choose to hibernate. As mentioned, it has wiped out over 90 percent of the common little brown bat colonies in the northeast, and has led to the northern long-eared bat becoming listed as a threatened species. And there is concern that it may threaten many other species with extinction.

And as also mentioned, bats are important economically for agriculture. The value that they may contribute ranges from $22 billion to $53 billion per year to agriculture across the U.S.

Chytrid fungus of amphibian is the most important disease to wildlife populations. Estimates are that chytrid may have already led to the extinction of 100 species, and may threaten populations of 200 more. When susceptible species are infected, chytrid causes reddening and thickening of the skin, thus preventing its normal function, which also disrupts water and electrolyte balance, leading to death.

The chytrid fungus is sensitive. It prefers moist environments, and will not survive below freezing or above 29 degrees Celsius.

Anthrax, the one disease that has not been previously mentioned, is caused by a bacteria and can be a major cause of livestock and wildlife mortality worldwide. Animals typically ingest anthrax spores on vegetation or soil. In the bloodstream, these replicate as vegetative cells and release toxins that rapidly kill the animal. When the tissues or blood from the carcass is exposed to air, the vegetative cells return to the spore form, and these spores are extremely hardy. They can literally survive for hundreds of years.

Endemic areas in the U.S., which include parts of Texas, Montana, and the Dakotas, normally only experience an occasional death. But occasionally, when conditions are right, huge outbreaks can occur. Such was the case in Texas this past summer. It is estimated that 10,000 animals may have died of anthrax, with an economic impact of over $15 million.

There is a safe and effective vaccine available to livestock. However, it is impractical to capture and restrain thousands of wild animals every year to vaccinate them. This is why researchers at Texas A&M University are working on an oral vaccine that can be fed to wildlife.

In conclusion, I would like to state how important it is that funding be made available to address wildlife diseases. I am particularly concerned with the lack of Federal funds available for research aimed at real world management dilemmas.

And with that, I thank you for inviting me here today.

[The prepared statement of Mr. Cook follows:]

U.S. Senate Committee on Environment and Public Works

Hearing Title:
"Examining the Impacts of Diseases on Wildlife Conservation and Management"

Testimony of

Walter E. Cook, DVM, PhD, DACVPM
Clinical Associate Professor
Wildlife Population Health Veterinarian
Texas A&M University

October 16, 2019

Chairman Barrasso, Ranking Member Carper, and Members of the Committee, thank you for the opportunity to provide a subject matter expert's perspective on disease challenges to wildlife conservation and management. My name is Dr. Walter Cook, and I am a clinical associate professor for Veterinary Pathobiology at Texas A&M University College of Veterinary Medicine and Biomedical Sciences. For more than 100 years, the Texas A&M College of Veterinary Medicine & Biomedical Sciences has been improving animal, human, and environmental health through teaching, research, veterinary care, service, and outreach.

Today I will highlight some of the lessons I've learned over the last 25 years dealing with many animal diseases. I will review five different wildlife diseases. Please note that there are many other diseases I could have chosen to review but I chose these five because I have particular concern and experience.

Chronic Wasting Disease (CWD) is a prion disease that affects the cervid or deer family (deer, elk, moose, caribou). Although it is related to Bovine Spongiform Encephalopathy (BSE) it is a distinct disease. Prions are infectious proteins that convert normal proteins found in the brain and other tissues into the abnormal prion configuration. When enough conversion occurs in the brain, microscopic holes appear and changes in behavior and body condition develop. As with other prion diseases, CWD is believed to be invariably fatal. Chronic Wasting Disease can be transmitted to other cervids directly via saliva, urine or feces, or indirectly when the environment gets sufficiently contaminated with these secretions or by decomposed tissue (particularly brain and spinal cord).

The disease was first recognized in a research facility in Colorado and quickly spread to a similar facility in Wyoming because the facilities traded animals back and forth. Since then it has been reported in 24 states, two Canadian provinces, South Korea and Norway, Finland and Sweden. The disease has caused declines in some populations in Colorado and Wyoming, but has not been associated with population declines in other areas. No one knows if this discrepancy is due to environmental factors, or if the unaffected populations just haven't had CWD long enough to be impacted. Still, CWD remains a major concern because once an environment gets sufficiently contaminated with CWD prions it is impossible to decontaminate; thus, long-term consequences could be severe.

As the name suggests, CWD causes animals to slowly deteriorate. In addition, it causes behavior changes and predisposes animals to early death due to predators, automobile accidents and other diseases. Chronic Wasting Disease is slow in all aspects, it slowly invades the animal's brain, is slowly transmitted and slowly spreads across the landscape (at least naturally).

Figure 1. A wild elk with CWD. Notice the extreme emaciation, yet relatively nice antlers. This elk died 15 minutes after this photo was taken. It is rare that animals reach this late stage of CWD in the wild as they are easy prey long before the disease is this pronounced. Photo courtesy of Dr. Melia DeVivo.

Due to the fact that CWD is the same category of disease as BSE, there have been concerns that like BSE it could spread to humans. To date there is no evidence to suggest that CWD is a significant human health threat. One should realize that there are many animal prion diseases and that, so far, only BSE has been shown to be transmissible to humans. Indeed, data collected by the Wyoming and Colorado Health Departments indicate that the risk of neurologic disease in those who have hunted in CWD endemic areas is no higher than the public at large. Dr. Christina Sigurdson of UC San Diego has developed an explanation for the low risk of transmission of CWD to humans (and most other non-cervids) referred to as the Steric Zipper Hypothesis. The idea is that much like how the teeth of a jacket or sleeping bag zipper must line up correctly for the zipper to work, so must the amino acid side chains of the prion and normal protein line up for conversion to occur. With unrelated species, the "teeth" of the zipper of these proteins do not line up so efficient conversion cannot occur. Despite the low risk of human disease, it is always prudent advice not to consume meat from any animal that is sick, regardless of the cause.

There is also concern that CWD could be transmitted to livestock. While many studies have shown that CWD can be transmitted to non-cervid or deer species via intracerebral inoculation (i.e. direct injection into the brain), no studies have shown that CWD can be naturally transmitted to livestock. Indeed, a recent study initiated by Dr. Elizabeth Williams (deceased) and completed

by her colleagues at the Department of Veterinary Science at the University of Wyoming indicates that natural CWD transmission to cattle is highly unlikely.

The public remains confused and concerned about CWD. There are several causes for this. First, there is a lack of understanding about the potential impacts of the disease. Secondly, there is the feeling among some interest groups that regulations regarding CWD are overly stringent. Third is the fact that different states manage CWD differently. While I support a state's right to manage the disease in a manner most consistent with that state's needs and values, it does lead to public confusion and distrust when they see states managing the disease in different ways. Fourth, there are a multitude of different messages concerning CWD. For example, one "authority" will claim that CWD is an imminent public health threat while another claims CWD is no threat at all. Similar mixed messages are also heard regarding population impacts on deer species. It would be ideal if an group of respected CWD authorities could determine common management needs and an overall public message

Lesson Learned: There are a lot of misconceptions about the impacts of CMD. A consistent avenue and reliable avenue for information dissemination is needed.

Bighorn Sheep Respiratory Disease Complex (BHSRDC). Bighorn sheep (BHS) are extremely susceptible to pathogens of the lungs. Huge outbreaks, often caused by a complex set of pathogens and stressors, have occurred and cause major impacts on BHS populations, in some cases eradicating entire populations. A typical scenario is that initially there is an "all age die-off" affecting a large proportion of the population. Typically, some adults will survive the initial outbreak. However, subsequently, the population fails to recruit young animals despite the fact that lambs are born. It is believed that the surviving adults have developed resistance to the pathogens but continue to harbor and shed them. Subsequently these pathogens get passed on to newborn lambs which die as they have no resistance.

While clearly not absolute, there is an association with domestic sheep having close contact with BHS prior to an outbreak. This has caused a great deal of contention between domestic sheep producers and wildlife managers and enthusiasts. Wyoming was the first state to resolve this conflict. This occurred when State Veterinarian, Jim Logan and State Wildlife Veterinarian Tom Thorne brought all the various interest groups together (The Wyoming State-wide Bighorn/Domestic Sheep Interaction Working Group) to resolve this conflict. They invited representatives of state and federal wildlife and livestock agencies, producers' groups, wildlife Non-Government Organizations and enthusiasts. Initially there was a great deal of enmity and resentment among the various interest groups. But by working from a set of ground rules and common goals the group became very effective. What I found inspiring is that people that previously difficulty working together became friends and colleagues. While the working group has not solved all disease issues, it has achieved great progress on resolving conflict.

Lesson Learned: When stakeholders from disparate groups come together in a good faith effort to resolve issues, disagreement can be reduced and progress can be made.

White-Nose Syndrome (WNS) of bats was first detected in New York (2006) and is caused by the fungus *Pseudogymnoascus destructans*. Today the disease is most common in the northeastern and Mid-Atlantic States and the fungus (but not the disease) has been found in a scattering of states further west. It kills by invading the skin of hibernating bats (seen as a white powdery growth on nose, ears and wings) and leads to emaciation which causes the bats to emerge from hibernation abnormally early in search of food. Because insects are rare in winter, food sources are scarce and the bats succumb to starvation, cold exposure or both.
The fungus responsible for WNS grows well in cold, dark and humid environments, the exact environment hibernating bats choose as hibernacula. White-Nose Syndrome has wiped out over 90% of the common little brown bat (*Myotis lucifugus*) colonies in the northeast, has led to the Northern Long-Eared Bat (*Myotis septentrionalis*) being listed as threatened, and has had a significant impact on 2 other related species. It is believed that WNS may significantly impact 25 or more species of bat and threaten many of them with extinction.

Interesting research conducted by Dr. Joseph Hoyt of Virginia Tech in Blacksburg shows some promise in preventing the disease. He found that probiotic bacteria (*Pseudomonas flourescens*) occasionally found on healthy bat skin inhibits the growth of the WNS fungus. When Dr. Hoyt and his team sprayed bats with a solution containing these beneficial bacteria, the chances of the bats surviving WNS was greatly increased.

Bats are important in controlling insects including mosquitoes and those that prey on crops and forests. Economic impacts on agriculture are estimated to be $22.9 Billion per year with some estimates as high as $53 Billion per year. Thus, even though many people dislike or even fear bats, they serve important roles in the ecosystem and benefit humans.

Lesson Learned: Wildlife Diseases can be important economically even when they affect species we may not normally appreciate.

Chytrid fungus (*Batrachochytrium dendrobatidis*) {Bd} of amphibians is probably the single most devastating disease agent for wildlife species in North America and across the globe. It has caused, "The most spectacular loss of vertebrate biodiversity due to disease in recorded history"[1] according to Dr. Lee Skerratt of James Cook University in Queensland, Australia. Estimates are that chytrid may already have led to the extinction of over 100 species and threatens populations of over 200 more. The chytrid fungus has spread around the world primarily by the trade in frogs (especially the Africa Clawed Frog) for food, pets, and research. Many of the traded species are carriers of the fungus and remain unaffected but can transmit chytrid to other species. When susceptible species are infected with Bd it causes reddening and thickening of the skin thus disrupting the normal function of the skin. This disrupts water and electrolyte balance and ultimately leads to death.

The chytrid fungus is quite sensitive to environmental conditions; it prefers moist environments and temperatures between 17 to 25^0 C and will not survive below freezing or above 29^0C. In fact, one can often save infected amphibians by placing them in warm environments. The fungus is also susceptible to most standard disinfectants. This is important as humans can transmit the organism from one water source to another if they fail to properly clean and disinfect nets, boots or other equipment that contacts amphibians or water.

Lesson learned: Trade in exotic amphibians led to the establishment of this fungus in the USA. We should be very careful about artificially moving wild animals. We also need to practice good biosecurity in wild places.

Anthrax. This disease, caused by the bacterium, *Bacillus anthracis*, is well known to anyone who remembers the terrorist letters of 2001. What most people do not realize is that anthrax is a major source of livestock and wildlife mortality across the globe. Animals typically ingest anthrax spores on vegetation or soil. When the spores invade the blood stream they replicate as vegetative cells and release toxins that can kill the animal in a matter of days. When the tissues or blood from the carcass is exposed to air, the vegetative cells sporulate- go back into the spore form. These spores are extremely hardy and can survive in harsh environments for hundreds of years. Endemic areas in the USA (the Edward's Plateau of Texas, the upper Midwest of Montana, South and North Dakota) will commonly experience a few deaths due to anthrax in wildlife or unvaccinated livestock every year. However, when conditions are right (typically a wet spring followed by a hot, dry summer) huge outbreaks can occur. This past summer was such a year in Texas and it is estimated that over 10,000 animals died of anthrax. The economic impact of this outbreak exceeds $15,000,000; this is remarkable considering the outbreak was limited to a 5-county area and most deaths occurred in a 2-month period. Not only is this an economic travesty but it is an environmental and humane issue as well. Amazingly, there was only one human case associated with this outbreak. Were it not for extensive public health education by the Texas Animal Health Commission, the Texas Parks and Wildlife Department and the Texas Department of State Health Services, there could have been many more human cases.

There is a very safe vaccine available to livestock that provides effective, but short-lived immunity (less than a year); most livestock producers in endemic areas vaccinate annually for the disease. However, it is impractical to capture and restrain thousands of wild animals every year to vaccinate them. This is why researchers at Texas A&M University are working on an oral vaccine that can be delivered to wildlife via a food bait.

Figure 2. Carcass pile of remains from wild animals that died of anthrax on a ranch in Uvalde, Texas. Photo courtesy of Glenn Staack.

Lesson Learned: Being proactive in educating the public can prevent catastrophic animal and human disease.

Finally, let me state that it is important that funding be made available to address wildlife disease management. I'm particularly concerned with the lack of federal funds available for research aimed at real world management dilemmas. There are federal funds supporting basic disease issues (like understanding what receptors are involved in certain pathogen invasion processes). However, there is a paucity of federal funds dedicated for research directed toward actual disease control which can also lead to increased human transmission.

References

1. Kurt. T.D., & Sigurdson, C. J. (2016). Cross-species transmission of CWD prions. Prion 10:83-91.
2. Skerratt, L. F., Berger, L., Speare, R., Cashins, S., McDonald, K. R., Phillott, A. D., ... & Kenyon, N. (2007). Spread of chytridiomycosis has caused the rapid global decline and extinction of frogs. *EcoHealth*, *4*(2), 125.

COLLEGE OF VETERINARY MEDICINE
& BIOMEDICAL SCIENCES
Department of Veterinary Pathobiology

TEXAS A&M UNIVERSITY

Walter E. Cook, DVM, PhD, DACVPM
Clinical Associate Professor
Wildlife Population Health Veterinarian
4467 TAMU
College Station, TX 77843-4467
979.845.5068
wcook@cvm.tamu.edu

December 3, 2019

Dear Chairman Barrasso and Ranking Member Carper,

Thank you for inviting me to testify at the Senate Committee on Environment and Public Works hearing on "Examining the Impacts of Diseases on Wildlife Conservation and Management" on October 16, 2019. I enjoyed the opportunity, and I am hopeful that my testimony was useful.

I also wanted to clarify a statement I made at about 46 minutes and 37 seconds into the hearing. I was talking about the susceptibility of cervids (the deer family) to Chronic Wasting Disease (CWD). I stated that all cervids are susceptible to CWD; I should have been clear that I was talking about all cervid species *native to North America*. There is evidence that fallow deer (a species native to Europe) may be resistant to natural infection with CWD, and there are many more exotic cervid species for which we have no evidence for their susceptibility to natural infection. This point will become relevant later.

I will now address the follow-up questions from the committee.

From Chairman Barrasso:

1. How could we improve communication among federal, state, private, and academic partners to share information in real-time to more efficiently and effectively address threats from and develop solutions to emerging wildlife diseases?

   There are groups such as the United States Animal Health Association. The Association of Fish and Wildlife Agencies and the Wildlife Disease Association that keep their members informed of wildlife disease events daily via email list serves and websites. This is an excellent mechanism for managers to stay informed about new diseases or occurrences of diseases in new areas. However, good communication about research advances that could be useful for managing wildlife diseases is lacking.

   Almost all high-quality wildlife disease research is published in "peer-reviewed" journals. However, such publications are often not accessible by wildlife managers because the journals themselves are not readily available and because the articles written are often very technical, quite lengthy, and not easily understood by non-experts. Some granting entities require brief annual reports summarizing important results in lay-person terms, in addition to publication in peer-reviewed journals. I think such a requirement for federal grants makes sense. These reports could then be shared with interest groups such

as those mentioned above so that their members would be aware of the progress being made.

2. In your testimony, you mentioned the Greater Yellowstone Interagency Brucellosis Committee as an example of effective collaboration to bring stakeholders together to fight brucellosis.

    a. In your view, what made this collaboration so effective, and are there any other examples of effective wildlife disease partnerships?

The primary reason that the Greater Yellowstone Interagency Brucellosis Committee was effective is that all stakeholders were represented: state wildlife agencies, state animal health officials, federal wildlife (WSFWS) and livestock agencies (USDA), federal land management agencies (BLM, USFS) university and agency researchers, and interest groups (cattle grower associations and wildlife enthusiasts). While all interest groups were represented, no one group was dominant. Meetings were held several times a year, and locations varied so that at least one meeting a year would be convenient for all members.

At the meetings, different strategies to manage brucellosis were discussed. Research results were presented, and ideas on how to incorporate findings into management were explored. Additionally, the group occasionally made recommendations on new research needs.

There are other examples of effective wildlife disease partnerships. In my written testimony, I briefly discussed the Wyoming State-wide Bighorn/Domestic Sheep Interaction Working Group. There are similar working groups in many states. These are effective when all stakeholders participate in good faith. Unfortunately, few working groups include federal agencies. The United States Animal Health Association (USAHA) permits and encourages participation from federal agencies. The USDA is typically well represented at the meetings. However, the USFWS generally is not very well represented. That may be due to the incorrect assumption that USAHA is only concerned with livestock health. In reality, there are several committees dedicated to wildlife health.

    b. You also mentioned that the role of the federal government should be to "facilitate more and regulate less." Outside of funding, how can the federal government facilitate these partnerships?

Historically, the federal government (particularly USDA), in conjunction with state agencies, regulated livestock diseases. These programs included testing requirements and movement restrictions that were imposed on livestock producers. These programs were very effective at eradicating and controlling diseases of domestic livestock. However, it is impossible to enforce disease testing and movement restrictions on free-ranging wildlife. In addition, the federal government does not have the authority to manage most wildlife-such authority is given explicitly to state agencies. A new paradigm that still respects

TVMC

4467 TAMU
College Station, TX 77843-4467

Tel. 979.845.5941 Fax. 979.845.9231
http://vetmed.tamu.edu/vtpb

state management authority must be found. Fortunately progress is being made toward that ideal.

Two good examples are the US Geological Services' National Wildlife Health Center and the US Department of Agriculture's National Wildlife Research Center. The scientists at these Centers conduct excellent research on several important wildlife diseases. The Centers' research is shared with committees at the USAHA. The research tends to be relevant, and some of it is collaborative; ideally more would be. It would be great to have the Centers represented in working groups or partnerships.

From Ranking Member Carper:

1. The public can play a major role in facilitating the spread of many wildlife diseases. For example, humans visiting caves can spread the fungus causing white-nose syndrome via contaminated clothing or equipment. People importing exotic frog species as pets can unintentionally cause the introduction of exotic diseases into native wildlife populations. Would you please elaborate on the role that public participation and education can play in minimizing the spread of wildlife disease? Is there anything Congress can do to improve opportunities for public education and engagement to reduce the spread of wildlife diseases?

   You listed some good examples of how people have inadvertently spread wildlife diseases. Very few people intentionally perpetuate wildlife diseases, once educated, they will alter their behavior to minimize the risks. The challenge is how to educate them.

   State and federal governments already offer a great deal of public information related to minimizing wildlife disease spread. I think the key now is to try to reach additional audiences that aren't being reached with current techniques. As mentioned, many diseases are moved by travelers. Educational articles or flyers could be put into traveler's magazines and at airports for example.

2. In your testimony, you discussed the need for amplified federal funding for research on wildlife disease. Although you noted that there is money to support research on basic disease issues, there is not enough funding dedicated to studying and developing methods to control and manage diseases on the ground. In your experience as a professor and as a veterinarian, would you provide a few examples of how scientific research has caused breakthroughs in the management of wildlife disease? How can Congress help ensure that funding for research on wildlife diseases is informed by the practical needs of wildlife managers?

   Research permitted the development of an oral vaccine for rabies control. This vaccine has been used to greatly reduce the occurrence of rabies in coyotes and raccoons in the southern USA.

TVMC

4467 TAMU
College Station, TX 77843-4467

Tel. 979.845.5941 Fax. 979.845.9231
http://vetmed.tamu.edu/vtpb

Research led to an understanding of how feeding elk increases brucellosis prevalence. This has led to the discontinuation of feeding in many areas and has changed how elk are fed in other areas. These changes are reducing prevalence of brucellosis in those herds.

A great deal of research has been done on drugs used to chemically immobilize wild animals. The drugs that are available to managers who need to capture wildlife are vastly superior in terms of human and wildlife safety than those of the past.

The best way to ensure that the practical needs of wildlife managers are met in research is to involve them in the grant-making process. Representatives from state and federal wildlife agencies should be allowed to help draft requests for research proposals and to review the actual proposals.

3. From DNA technologies to novel vaccines, scientists and managers have proposed innovative technologies and methods to monitor and manage outbreaks of disease in wildlife populations. What role does innovative research and technology play in preventing or mitigating the diseases that you study or manage?

   Anthrax is an important disease in Texas, and severe outbreaks can kill thousands of wild animals. I am working with a collaborator who has develop a technique to microencapsulate a vaccine for anthrax. This microencapsulation technology allows the vaccine to be incorporated into a feed bait so that managers can orally vaccinate wildlife against anthrax.

   Many states allow the private ownership of exotic cervids. There are at least eight species of exotic cervid that could potentially be susceptible to Chronic Wasting Disease (CWD). It is impossible to manage a disease when you don't know which species might be susceptibleI hope to collaborate with Dr. Christina Sigurdson of UC San Diego to use her steric zipper technology to determine which, if any of these species, may be susceptible to CWD.

   Monitoring the health status of wild animals is very difficult. Many of our most treasured wild species are prey species. Because predators select for sick prey, prey species typically try to hide the fact that they are sick. Thus, by the time they become visibly ill, they are usually too severely impacted to be successfully treated. I am working with an innovation company to develop an implantable device that will allow us to monitor wild animals' health parameters remotely. This will allow for early detection of disease and possible treatment options.

I hope you find this information helpful. I would be happy to provide further information if you desire it.

Sincerely,

Dr. Walter Cook

TVMC

4467 TAMU
College Station, TX 77843-4467

Tel. 979.845.5941 Fax. 979.845.9231
http://vetmed.tamu.edu/vtpb

Senator BARRASSO. Thank you very much, Dr. Cook. We are delighted that you would accept the invitation to be with us and share your knowledge. Thank you.

We will get to questions in a bit. But first, Ms. Niederriter.

STATEMENT OF HOLLY NIEDERRITER, ENVIRONMENTAL SCIENTIST IV AND NON-GAME MAMMAL BIOLOGIST, DELAWARE DIVISION OF FISH AND WILDLIFE, DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL

Ms. NIEDERRITER. Good morning, and thank you for this opportunity to discuss this very important issue of wildlife disease and its impact on wildlife conservation and management.

The information that I will present today will reflect my experience with bats, amphibians, and reptiles and the diseases they encounter, and is not intended to diminish the importance of any of the other wildlife diseases mentioned here today or those not mentioned. Certainly, diseases such as chronic wasting disease that affect deer, elk, and similar species, rabies, avian influenza, which has the potential to substantially impact the billion dollar poultry industry, mosquito-borne diseases, such as malaria, West Nile and Zika viruses, and a host of other diseases are of concern and can benefit from actions taken by this committee today and others. However, I will only address the issues with which I am most familiar.

Although disease is a normal part of life, and the battle between pathogen and host has been going on since the beginning of time, the rapid transport of pathogens over vast distances is a relatively new phenomenon, at least for the species I am responsible for. As technology has promoted human travel as well as international commerce, to include pets, foods, and wildlife, pathogens have hitchhiked along and been accidentally introduced into wildlife populations. Wildlife exposed to new pathogens lack the immunity necessary to fend off disease, and the results can be catastrophic, as was seen and is still seen with white-nose syndrome in bats.

Examples include white-nose syndrome in bats, which has killed millions of bats at this point; chytrid fungus, which has been mentioned today also. There has also been widespread declines in amphibians from chytrid fungus, and ranavirus has been impacting frogs, salamanders, and turtles and is one of those emerging diseases.

Recently, snake fungal disease has been documented on many snake species in the United States, and a new species of chytrid fungus has resulted in die offs of salamanders in Europe. The impact of an emerging disease on wildlife managers at the State level has profound impacts on our projects. The need to immediately address diseases often derails other important objectives, and funds are diverted from more proactive projects.

In Delaware, the introduction of white-nose syndrome diverted over half the time of one of the biologists, which was a substantial operational impact in a State as small as Delaware. The effects of wildlife diseases extend to other species, habitats, human health, agricultural health, and even economic health. As mentioned before, bats consume insects that feed on crops and can save farmers billions of dollars in pesticide application costs.

And that really does not include the environmental and pesticide development costs of the increased need for pesticides to sustain productive agriculture. White-nose syndrome has been mentioned several times already, but it is worthy of those mentions. It has decimated bat populations. As has been mentioned before, it has killed millions of bats, and it continues to spread throughout North America.

I have a map here. The disease itself has been documented in 33 States and 7 Canadian provinces, and the fungus that causes it, Pseudogymnoascus destructans, has been reported in five additional States, including North Dakota and California this year.

Northern long-eared bats, now federally listed as threatened due to white-nose syndrome, were once one of the most abundant bat species in the United States. Losing them would be analogous to the American robin and northern cardinal suddenly disappearing from people's back yards and feeders.

The white-nose syndrome response has been unique in that the United States Fish and Wildlife Service was appointed the lead agency to manage the national response. They have played a key role in planning, coordinating partners, funding research, and monitoring efforts by State agencies, universities, and others. Major progress has been made as a result, and many tools for combating white-nose syndrome are being tested.

None of this would have been possible without a central Federal lead and consistent funding. However, none of this funding is dedicated, as it is appropriated yearly, which puts many of the proposed solutions at risk of not reaching their full potential.

The northeast region has a strong, collaborative network of Federal and State biologists, supported through regional taxa groups such as Northeast Partners in Amphibian and Reptile Conservation, Northeast Bat Working Group, and the Northeast Wildlife Disease Cooperative. Delaware is involved with all of those groups and has participated in many of these projects.

One of those projects was led by Maryland's herpetologist, Scott Smith. And the goal was to determine the extent of ranavirus in a five State area. Ranavirus is a deadly virus that affects frogs, turtles, and salamanders, and it can kill all the tadpoles present in a given pond in a matter of days.

The results of this project were alarming, with over 25 percent of the breeding ponds tested in five States positive for ranavirus, and 40 percent of the ponds in Delaware tested positive. All of the States had ponds that experienced full die offs for all the tadpoles in the pond that year.

Despite the results of this and other studies, continued sampling and research in our region has been limited. Although there are many organizations and people dedicated to protecting wildlife of all kinds, and there are many effective disease response teams targeting specific diseases, the United States lacks a central organizing group that can quickly coordinate and mobilize in the event of another catastrophic wildlife disease.

Diseases transcend political boundaries, and the issue would benefit from a dedicated, fully funded, federally based wildlife disease task team to assist States when novel pathogens are encountered, and with ongoing research and surveillance efforts for existing and

imminent diseases. Additionally, expanding and strengthening Federal laws to prevent the introduction of foreign wildlife could greatly reduce the chances of new diseases being introduced.

I want to thank you again for the opportunity to testify today.

[The prepared statement of Ms. Niederriter follows:]

STATE OF DELAWARE
DEPARTMENT OF NATURAL RESOURCES &
ENVIRONMENTAL CONTROL
DIVISION OF FISH &WILDLIFE
89 Kings Highway
Dover, DE 19901

WILDLIFE SECTION

Phone: (302) 739-9912
Fax: (302) 739-6157

United States Senate Committee on Environment and Public Works
Wildlife Disease and its Impact on Wildlife Conservation and Management

October 16, 2019

Holly Niederriter, Wildlife Biologist
Delaware Department of Natural Resources and Environmental Control
Division of Fish & Wildlife
Species Conservation and Research Program

Good morning and thank you for the opportunity to discuss the issue of wildlife disease and its impact on wildlife conservation and management. My name is Holly Niederriter and I am a wildlife biologist with Delaware's Species Conservation and Research Program within the Department of Natural Resources and Environmental Control's Division of Fish & Wildlife. The information I present today will reflect my experience with bat, reptile and amphibian diseases, and is not intended to diminish the importance of other wildlife diseases or the species affected by them. Certainly, diseases such as chronic wasting disease that affects deer, elk and other similar species; West Nile and Zika viruses, both spread to humans by mosquitos; rabies; avian influenza, which has the potential to substantially impact the billion dollar poultry industry; and a host of other diseases are of concern and can benefit from actions taken by this committee and others. However, I will only address the issues with which I am most familiar.

Although disease is a normal part of life and the battle between pathogen and host has been going on since the beginning of time, the rapid transport of pathogens over vast distances is a relatively new phenomenon, at least for the species with which I work. As technology has promoted human travel as well as international commerce to include pets, food and wildlife, pathogens have hitch-hiked along and have been accidentally introduced into wildlife populations. Wildlife exposed to new pathogens lack the immunity necessary to fend off disease and the results can be catastrophic. Additionally, landscapes in the United States have undergone huge transformations over the past century, and those changes have stressed many species, leading to compromised immune systems and avenues for emerging diseases to take hold.

White-nose syndrome (WNS) has killed millions of bats and widespread declines have been observed in amphibians from *Batrachochytrium dendrobatidis* (a type of chytrid fungus) and in frogs, salamanders and turtles from ranavirus. Recently, Snake Fungal Disease has been documented on many snake species in the United States and a new species of chytrid fungus has resulted in die-offs in salamanders in Europe (*B. salamandrivorans, Bsal*). The impact of an emerging disease on wildlife managers and their projects at the state level can be profound. The

need to immediately address diseases often derails other important objectives and funds are diverted from more proactive projects. In Delaware, the introduction of WNS diverted over half the time for one biologist, which had a substantial operational impact on our small state that only has a handful of biologists to address the needs of a variety of wildlife species.

The effects of wildlife diseases extend to other species, habitats, human health, agricultural health and even to economic health. For example, bats consume many insects that feed on crops and are thought to save farmers from 3.7-5.4 billion dollars per year in pesticide application costs. And that does not include the environmental and pesticide development costs of the increased need for pesticides to sustain productive agriculture.

Bats are a recent and ongoing example for the impact of disease on wildlife populations. White-nose Syndrome has decimated bat populations, already killing millions of bats and it continues to spread throughout North America. The disease has been documented in 33 states and seven Canadian provinces, and the fungus that causes it, *Pseudogymnoascus destructans,* has been reported in five additional states (including North Dakota and California this year). Northern long-eared bats, now federally-listed as threatened, were once one of the most abundant species in the United States and now they are rarely encountered in states where WNS has been documented. This would be analogues to if the American robin or northern cardinal suddenly disappeared from lawns and bird feeders.

The WNS response has been unique in that the United States Fish and Wildlife Service was appointed as the lead agency to manage the national response. They have played a key role in planning, coordinating partners, and funding research and monitoring efforts by state agencies, universities and others. Major progress has been made as a result, and many tools for combating WNS are being tested. None of this would have been possible without a central federal lead and consistent funding. However, none of this funding is dedicated as it is appropriated yearly, which puts many of the proposed solutions at risk of not reaching their full potential.

In Delaware, we did not have much historical data on bat populations before WNS arrived. However, we were able to collect data before losing many of our bats and we now know that we have lost most (if not all) of our little brown and northern long-eared bats. We are working to protect our remaining bats, prevent the spread of WNS and collect data on bat distribution so that we can protect any rare species that might remain.

The northeast region has a strong, collaborative network of federal and state biologists, supported through regional taxa working groups such as the Northeast Partners in Amphibian and Reptile Conservation (NEPARC), Northeast Bat Working Group (NEBWG) and Northeast Wildlife Disease Cooperative (https://www.northeastwildlife.org/). Delaware is involved with all those groups and has participated in many regional projects. The Northeast Wildlife Disease Cooperative has helped Delaware and other states compile disease response plans. However, not all northeastern states are part of this organization, and participating states do not all have the same plan and there is no interstate coordination of the plans. Although this cooperative provides a foundation for effective disease response by providing information, training, laboratories for sample processing and central organization for reporting disease events, it does not yet have the ability to provide central coordination for widespread disease response. The regional NEPARC group is part of a larger organization, Partners in Amphibian and Reptile Conservation (PARC) that has other regional and state chapters. Both the regional groups and the lead group, PARC, have led the way for many projects that transcend state boundaries and have been instrumental in producing action plans and projects to address wildlife disease and other issues. However, most of the people are volunteers or agency employees trying to find the time to address the issues on their spare time, so progress can be slow. Although PARC provides a good structure for the national organization, wildlife disease issues need more dedicated resources.

The northeast has a federally-funded regional State Wildlife Grant (SWG) program that supplies pooled SWG funds for regional projects. Delaware participated in one of those regional studies, led by Maryland's herpetologist, to determine the extent of ranavirus, a deadly virus that can kill all the tadpoles present in a pond in a matter of days. The results were alarming; over 25% of frog breeding ponds tested in five states were positive for ranavirus, including 40% of tested Delaware ponds. Despite the results of this and other studies, continued sampling and research in our region has been limited.

Although there are many organizations and people dedicated to protecting wildlife of all kinds, and many effective disease response teams, targeting specific diseases, the United States lacks a central organizing group that can quickly coordinate and mobilize in the event of another catastrophic wildlife disease. Diseases transcend political boundaries and this issue would benefit from a dedicated, fully funded federally-based wildlife disease task team to assist states when novel pathogens are encountered and with ongoing research and surveillance efforts for existing and imminent diseases. Additionally, expanding and strengthening federal laws to prevent the introduction of foreign wildlife could greatly reduce the chances of new diseases being introduced.

Brief Information about WNS and Select Amphibian and Reptile Diseases

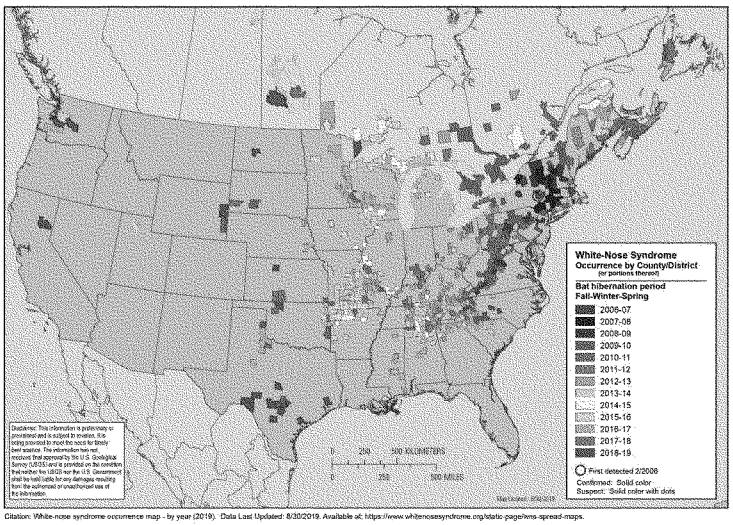
White-nose Syndrome in bats:

White-nose Syndrome (WNS) is caused by a fungus (*Pseudogymnoascus destructans; Pd)* that only grows in cold, damp places and attacks bats while they hibernate and their immune systems are suppressed. The fungus was unknown to science prior to WNS. The fungus invades cells and interrupts physiological processes, waking the bats and causing them to burn the fuel they need to survive the winter. In some cases, declines in large cave colonies have been as high as 99% and the floor of caves have been littered with carcasses. It has been described and as the worst wildlife mortality event known in North America.

Pathogen Origin: The fungus occurs in Europe and Asia, where it is believed to have existed for a long time and where bats seem to have developed immunity and do not seem to be affected. The strain found in North America is believed to have originated in Europe.

Disease Transmission: It can be passed from bat to bat and substrate to bat and the spores can survive on substrate in hibernation locations and in summer colonies in a dormant phase for an unknown length of time. The fungus can only grow on bats at specific temperatures and humidity and only when bats are in torpor. Because the spores are microscopic, cannot be visually detected and can last a long time on clothing and equipment, it is important to disinfect clothing and gear when leaving WNS-impacted locations.

Species impacted: Twelve hibernating bat species have been confirmed with WNS in the United States. Two species are currently being assessed to determine if federal listing is warranted due to WNS (little brown and tri-colored) and one species has been listed as threatened due to WNS (Northern long-eared bat). Many states have added WNS-impacted species to their endangered species lists.



Citation: White-nose syndrome occurrence map - by year (2019). Data Last Updated: 8/30/2019. Available at: https://www.whitenosesyndrome.org/static-page/wns-spread-maps.

Figure 1. Range map for White-nose Syndrome. https://www.whitenosesyndrome.org/static-spread-map

Response: Since 2008, the United States Fish and Wildlife Service has produced and implemented a National Plan for combating WNS. In addition to coordinating working groups with specific goal areas (Disease Management, Conservation and Recovery, Surveillance & Diagnostics, Data Management and Communications & Outreach), they have provided funding to partner agencies to implement the plan and have awarded grants to partners to conduct research into solutions.

The WNS community has made extraordinary progress and many tools for combating WNS are being testing; a fungal vaccine, biologically derived compounds to kill or slow the growth of the fungus, use of UV light to kill the fungus on bats and in their environment and manipulation of temperature and humidity of environments are just a few examples. A monitoring program was also started as a product of the national response. The North American Bat Monitoring Program is standardizing monitoring methods to allow for compilations and data comparisons that are not bound by political boundaries.

Ranavirus (Amphibians and Reptiles)

Ranavirus has caused mass mortality events in amphibians and die-offs of turtles in both captive and wild populations. Some ranaviruses can be transmitted among amphibians, reptiles and fish. In the United States, ranavirus has been detected in over 25 states and is known to effect at least 20 different species of turtles and over 91 amphibian and reptiles species in North and South America. While ranaviruses have been reported from reptiles in captivity for years, there are a growing number of reports of mortality in free-ranging populations over the past decade. Ranaviruses are also moved regionally and internationally in the animal trade.

Pathogen Origin: Unknown, but it is part of a large genus that can infect amphibians, reptiles and fish.

Disease Transmission: Transmission of ranavirus occurs through direct contact, ingestion of the virus, ingestion of infected animals or exposure to infected soil or water sources. Because ranavirus most severely affects amphibians and reptiles in the larval stage, mortality events tend to be seasonal. Though they are poorly understood at present, ranaviruses are believed to persist in the environment for a period of time and can likely survive for months in water under favorable conditions.

Research has shown that amphibians exposed to stressors such as herbicides and insecticides can make individuals more susceptible or epidemics more severe. Low-level infections may not kill all individuals and likely may keep the virus present in wetlands.

Response: There is no treatment or cure for ranavirus and management is typically quarantine if in captivity. Northeast Partners in Amphibian and Reptile Conservation (NEPARC) has produced recommendations and a video showing how to disinfect gear. A global Ranavirus Consortium was formed in 2011 (https://www.ranavirus.org/) that meets annually to share news and collaborate, and an open access on-line book was produced in 2015 by lead researchers (https://link.springer.com/book/10.1007/978-3-319-13755-1).

Woodfrog tadpoles infected by ranavirus in Blackiston Wildlife Area in Delaware in 2014. Two days after this photo was taken, all tadpoles were gone; likely died and consumed by other species.

Chytridiomycosis*; also known as Chytrid fungus or Bd,* (impacts Amphibians)*:*

Chytridiomycosis is caused by the fungus *Batrachochytrium dendrobatidis (Bd)*. It is widespread now, occurring on every continent that has amphibians and has the potential to affect any species of amphibians. It weakens the skins of amphibians, making it difficult for them to absorb nutrients and take in water, eventually resulting in suffocation. It has resulted in serious declines of over 200 species and the extinction of at least three species in Central America. It has its more deleterious impacts at higher elevations, where it thrives in moist, cool conditions. Some species of frogs, including American bullfrogs, can be reservoirs, passing the disease on to other frogs without becoming sick themselves. It has been implicated in mass die-offs and extinctions of frog species in Central America.

Pathogen Origin: Unknown, but thought to possibly have originated from the African clawed frog and have been further distributed by American bullfrogs. Both species can carry the pathogen without acquiring the disease.

Disease Transmission: Directly from skin of infected individuals, on substrate such as wet soil (even on equipment) or through exposure to *Bd*-infected water.

Response: Captive individuals can be treated with antifungal medications, but there are no methods for treating free-ranging populations or habitats. Management is similar to other amphibian diseases where disinfection of clothing and gear is recommended whenever working in wetlands. Similar to ranavirus, there are networks of organizations collecting data and working on solutions, but there is not a central coordinating entity.

***Batrachochytrium salamandrivorans*, or Bsal** (impacts Salamanders):

A new amphibian fungal pathogen "Bsal" was identified in 2013 from a wild salamander die-off in Europe. Although Bsal is not known to occur in North America, currently studies have determined that it is lethal to North American salamander species and pathways for its entry into North America exist. Interagency and international collaboration and action will be essential to prevent or reduce risk of Bsal introduction to the United States, Canada and Mexico.

Pathogen Origin: Native to Asia, where Asian salamanders carry the fungus without showing signs of disease. Asian salamanders are held in international captive collections and are common pets; of the nearly 3 million salamanders imported to the United States over the past decade, >85% were Asian salamanders. First detected and identified in the Netherlands, in the last year Bsal has been detected in captive salamanders in the United

Kingdom. This pathogen has proven lethal to multiple salamander species in both captive and wild situations. It is an emerging infectious disease that is at an early stage of global transmission. Wildlife scientists and managers aim to contain or treat infected animals in captive situations, and preempt the pathogen's introduction to wild populations outside its Asian range.

Response: A Bsal Task Force was initiated at an international workshop hosted by the United States Geological Survey in June 2015 that focused on emerging disease management, policy and research implications of *Batrachochytrium salamandrivorans* http://www.salamanderfungus.org/. The Bsal Rapid Response Plan template was rolled out in June 2018 and is the product of a collaborative effort between the Association of Fish and Wildlife Agencies' (AFWA) Amphibian and Reptile Conservation Committee and the Bsal Task Force, which is made up of partners from federal and state agencies, non-profit organizations, universities and other research organizations, zoos and representatives of the pet trade. The organizational structure is patterned after the WNS Response Team.

This section derived from https://parcplace.org/wp-content/uploads/2017/08/BsalBrief.pdf and http://www.salamanderfungus.org/.

Senate Committee on Environment and Public Works
Hearing entitled, *"Examining the Impacts of Diseases on Wildlife Conservation and Management."*
October 16, 2019
Questions and Responses for the Record for Ms. Niederriter

Ranking Member Carper:

1. At the hearing, you provided an explanation of how climate change affects the incidence and spread of wildlife diseases. Would you provide examples of how climate change has influenced the spread of the different diseases which you work on or are familiar with?

   Climate change presents one the greatest challenges to biodiversity and has the potential to weaken ecosystems worldwide. Increased storms, drought, floods, hurricanes and changes in air and water temperature and quality are predicted. There is no doubt that a changing climate will impact wildlife and wildlife diseases but the connections are not always direct. Disease emergence is a complex phenomenon and examining single factors may be misleading as most situations are non-linear and outcomes depend on a number of factors.

   Overwhelming evidence exists for climate-induced changes in seasonal timing of plant and animal activities and shifts in species' geographic ranges (Walther et al. 2002). Many pathogens can exist at low levels in animals and their habitats but not be expressed as illness until an external stressor, including those associated with climate, are experienced.

   Amphibians may be the group most vulnerable to climate change due to their moist, permeable skin, their need for both wetlands and uplands to complete their life cycles, and their central location in the food web. They are already considered the most vulnerable group of vertebrates with approximately one third of all species imperiled worldwide. Several emerging amphibian and reptile diseases, as well as mammal, insect, rodent and fish diseases have direct, though not always linear, relationships to temperature.

   Below are a few examples of wildlife disease impacted by changing climatic conditions.

   Ranavirus is an infectious disease of amphibians, reptiles and fish caused by viruses from the genus *Ranavirus*. It has caused mass mortality events in amphibians and die-offs of turtles in both captive and wild populations. Ranaviruses are primarily transmitted by affected animals but are also accidentally moved locally by humans and internationally via the pet trade. Ranavirus thrives in warmer conditions. Recent research with four frog species demonstrated a direct link between viral growth and temperature (Brand et al. 2016). In a study with woodfrogs (*Lithobates sylvaticus*) a 2°C increase (10 vs. 12°C) in water temperature resulted in increased growth of the virus and 90% mortality of the exposed tadpoles.

   Batrachochytrium dendrobatidis (Bd) and ***Batrachochytrium salamandrivorans (Bsal)*** are fungal diseases affecting frogs and salamanders. The pathogen has been found on every continent except Antarctica, has been indicated in the extinction of many species, especially in Central America, and has impacted over 700 species globally. If the climate warms, it will move into new areas and impact new populations. ***Bsal*** originated in Asia

and was accidentally introduced into wild populations of salamanders in the Netherlands and Belgian, where it caused large-scale mortality. It has since been documented in a wild population and captive populations in Germany. Like most diseases, its ability to grow and its impact on hosts is temperature-related. This pathogen demonstrated highest growth and host mortality at 10-15°C (Martel et al. 2013) while *Bd* idea temperatures are bit higher; 17-55°C (Piotrowski et al. 2004). Although both pathogens are associated with cooler temperatures and higher altitudes, climate models predict that *Bd* will shift to higher latitudes and altitudes and experience an overall expansion into suitable habitats in the Northern Hemisphere and impact additional species in the process (Xie et al. 2016).

White-nose Syndrome (WNS), climate change and little brown Myotis: The catastrophic impacts of WNS on multiple cave bat species is well documented with the smaller species such as little brown Myotis (*Myotis lucifigus*), Indiana bats (*Myotis sodalis*), and northern long-eared Myotis (*Myotis septentrionalis*) suffering the greatest declines. Impacts of climate change are likely to add to the population reductions. A study demonstrated that predicted droughts associated with climate change will reduce food availability to female little brown *Myotis* early in the season, resulting in delayed reproduction, which is associated with lowered survival of young (Frick et al. 2010).

Ichthyophonus (ICH) is caused by a widespread parasite that affects many fish species including commercial species such as Salmon and Herring. Fish disease organisms are always present in the water but, as salmonid species become stressed by higher water temperatures, their resistance decreases and the possibility of disease epidemics increases (Guillen, 2003). Additionally, diseased fish are likely more susceptible to predation as their speed and agility are affected by illness.

Salmon need cold, fast running streams and, in Alaska's Kuskokwim and Yukon Rivers, biologists have reported water temperature increases of 3 - 4°C. In addition to the warmer water stressing the salmon, it also accelerates growth of the parasite microbe ICH. Infections were first documented in the Yukon River system in the 1980s and have resulted in decreased salmon swimming performance, increased mortality, and diminished meat quality. Decreased harvest and low quality meat will likely impact native tribes as well as food industries and consumers.

Plague is caused by the bacterium *Yersinia pestis*, which impacts rodents and other mammals and is spread primarily by fleas. Changes in temperature and rainfall affect the distribution of the vectors as well as the host rodent populations, which will affect the range of rodent-borne diseases such as plague.

Also see deer and moose disease examples in response to Question 2 below.

2. Senator Braun asked you about the impacts of climate change on the spread of chronic wasting disease. Although you noted that you were not familiar with chronic wasting disease specifically, you were aware of other diseases affecting cervids that are influenced by climate change. Would you please elaborate on these diseases?

Hemorrhagic Disease (HD) is caused by the related viruses bluetongue virus (BTV) and epizootic hemorrhagic disease virus (EHDV). This family of virus can affect deer, sheep, cattle, goats, and potentially domestic dogs. Historically found in southern states of the U.S., the virus is spread by biting midges of the genus *Culicoides*. Average temperatures in winter and summer months, as well as precipitation in late summer/early fall appear to be major factors affecting HD prevalence/outbreaks. Research laboratories monitoring HD presence in white-tailed deer have observed a northern expansion and increased detection of HD in recent decades. While several habitat, climate, and landscape variables may be the cause, climate change is thought to be one of the driving forces (Stallknecht 2015).

Meningeal worm (brain worm) is a parasite that white-tailed deer can consume when eating an infected snail or worm. The deer are minimally affected but can spread the larvae as a carrier species. In moose, and a few other species, the parasite affects their nervous system and can result in paralysis (death), inability to feed (starvation), or abnormal behavior (high concern for human-wildlife conflict). As the white-tailed deer range expands north due to climate and habitat shifts, an increased prevalence of meningeal worm in moose has also been observed.

3. As you mentioned in your testimony, managing wildlife disease is challenging because wildlife move freely across state and local boundaries. Since states are responsible for managing wildlife within their borders, different management practices and laws between states can make it difficult to prevent the spread of diseases. In your opinion, how could the Federal government better promote consistency and facilitate coordination between states to minimize the introduction or spread of wildlife diseases across borders?

Level of problem: There are many active non-governmental groups and governmental agencies working on specific diseases or suites of species but there is no central coordination of those groups, dedicated funding to support their efforts, or central planning or emergency response team able to react quickly to emerging issues. When outbreaks occur, states and federal agencies are forced to respond as best as they can with the resources they have, which is rarely, if ever, adequate to address the issue quickly, thoroughly or efficiently. Therefore, known diseases are not getting the level of attention necessary for prevention, monitoring or containment and emerging diseases are not managed in a timely or coordinated manner.

Proposed solution: The federal government could best promote wildlife health and assist states by providing the central organizing structure needed. A coordinating entity similar to the USFWS' WNS Response Team would be a good basic model but an approach similar to the USDA's Animal Health Protection Act, designed to protect agriculture industry/species, would provide additional elements that would make for a more comprehensive approach to wildlife diseases.

An approach for comprehensive wildlife health protection should include the following elements at a minimum.

- A clean trade regulation to provide biosecurity similar to that used to prevent importation of pests damaging to agricultural industries. Clean trade in wildlife

goods would involve prevention of importation of injurious species and should also require testing for pathogens.

- Dedicated funding and staff.
- State support and liaisons. The WNS Response team has coordinators for each region who are tasked with assisting states and working with them to maximize the effectiveness of projects.
- Emergency/rapid response planning.
- Financial support for research.
- Biosecurity oversight for commercial wildlife farming (including turtles, frogs and cervids).
- Biosecurity oversight for wild-caught animals kept as pets.
- Diagnostic laboratory support.
- Outreach and education.
    - Don't turn it loose campaigns.
    - Disease alert system.
    - Social Media.
    - Disinfection protocols and best management practices.
    - Wildlife rehabilitation biological security guidelines.
    - Citizen science where appropriate.

Issues that could be addressed with a wildlife health protection approach: Chronic wasting disease was first documented decades ago and, if a team and resources had been in place to quickly control the spread, it may have never reached many of the locations currently impacted. White-nose Syndrome is another example. Although a team now exists that is addressing the disease from every possible angle, no group was in charge initially and it took five years for a coordinated plan to be completed, by which time the disease had spread to 15 states and three Canadian provinces.

This type of approach is urgently needed as an increasing number of wildlife diseases emerge or are discovered. For example, *Bsal*, although it was discovered in 2013, is still a threat in this and other countries. The U.S. is home to the largest diversity of salamander species in the world and many could be impacted, even eradicated, if *Bsal* were to be introduced to the US.

Protecting wildlife species from diseases also protects human and economic health. Many wildlife diseases overlap with human diseases (Lyme disease, plague, rabies, avian influenza) and wildlife supports the economy by attracting tourists, hunters, anglers and other outdoor enthusiasts. Not preventing diseases can be costly: Post-exposure rabies vaccinations for 665 people who had potential contact with a single rabid kitten in a pet store in New Hampshire cost $1.1 million, and it has been estimated that the economic burden of Lyme disease treatment in the United States may be around $500 million annually (Dazak et al. 2000).

4. The public can play a major role in facilitating the spread of many wildlife diseases. For example, humans visiting caves can spread the fungus causing white-nose syndrome via contaminated clothing or equipment. People importing exotic frog species as pets can unintentionally cause the introduction of exotic diseases into native wildlife populations. Would you please elaborate on the role that public participation and education can play in minimizing the spread of wildlife disease? Is there anything Congress can do to improve opportunities for public education and engagement to reduce the spread of wildlife diseases?

   Congress can increase public engagement and education by including an outreach and education element in the wildlife health protection approach when it is developed. A wildlife disease alert system that includes contact information, fact sheets and instructions on what to look for and how to report concerns, information on not releasing pets, disinfection protocols and opportunities for citizen science could be included. In my experience, the public cares deeply about wildlife and wants to help when problems arise. Volunteers in Delaware flock to assist with horseshoe crab and shorebird surveys, diamondback terrapin rescue projects, invasive species removal and bat monitoring and information events. If given the information and opportunity, people will support efforts to protect wildlife from diseases.

5. From DNA technologies to novel vaccines, scientists and managers have proposed innovative technologies and methods to monitor and manage outbreaks of disease in wildlife populations. What role does innovative research and technology play in preventing or mitigating the diseases that you study or manage?

   Innovative research techniques play a huge role in addressing wildlife disease issues. Updated technologies assist with all aspects of wildlife management, from how we collect samples, record data, process biological samples, capture animals and communicate methods and results. Techniques for detecting pathogens and host species' presence in wetlands and waterways (e.g., eDNA) are being developed for many species. For a better understanding of bat and bird migrations, there is the relatively new technology of nano-tags and towers that record information when a bat or bird with a tag passes near the tower. For bats, the WNS Response Team has funded research into biological (beneficial bacteria, natural antifungal bacteria), chemicals to inhibit pathogen growth (B23 and polyethylene glycol 8000), genetic manipulation, vaccine trials and mechanical (habitat manipulation, ultraviolet light) designed to control *Pseudogymnoascus destructans*. There is always a need for improved technology. For example, there is a need to find a method to speed up the processing of samples, especially if it could be done while in the study site with the animal, and for improved telemetry options for tracking small animals remotely and for detecting pathogens in the field.

Literature Cited

Brand, M. D., R. D. Hill, R. Brenes, J. C. Chaney, R. P. Wilkes, L. Grayfer, D. L. Miller, and M. J.Gray. 2016. Water temperature affects susceptibility to ranavirus. *EcoHealth* 13: 350–359.

Daszak, P, A. Cunningham, and A. D. Hyatt. 2000. Emerging infectious diseases of wildlife – threats to biodiversity and human health. *Science* 287: 443–49.

Frick, W. F., D. S. Reynolds, and T. H. Kunz. 2010. Influence of climate and reproductive timing on demography of little brown Myotis *Myotis lucifugus*. *J. of Animal Ecology* 79:128-136.

Guillen, G. 2003. Klamath River fish die-off, September 2002: Causative factors of mortality. Report number AFWO-F-02-03, U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office. Arcata, CA. 128 pp.

Martel, A., M., Blooi, C., Adriaensen, P. Van Rooij, and W.Beukema. 2013. Recent Introduction of a Chytrid Fungus Endangers Western Palearctic Salamanders. Science 346(6209): 630-631.

Piotrowski JS, Annis S. L., and Longcore J. E. 2004. Physiology of *Batrachochytrium dendrobatidis*, a chytrid pathogen of amphibians. Mycologia 96: 9-15.

Stallknecht, D.E., A. Allison, A. Park, Phillips, V. Goekjian, V. Nettles, and J. Fischer. 2015. Apparent increase of reported hemorrhagic disease in the Midwestern and northeastern USA. *J. of Wildl Dis* 51(2):348–361.

Walther, G. R., E. Post, P. Convey, A. Menzel, C. Parmesan, T. J. C. Beebee, J-M. Fromentin, O. Hoegh-Guldberg, F. Bairlein. 2002. Ecological responses to recent climate change. *Nature* 416: 389-395.

Xie, G. Y., Olson D. H., Blaustein A.R. 2016. Projecting the Global Distribution of the Emerging Amphibian Fungal Pathogen, *Batrachochytrium dendrobatidis*, Based on IPCC Climate Futures. *PLoS ONE* 11(8): e0160746. doi:10.1371/journal.pone.0160746.

Senator BARRASSO. Thank you very much to all three of you.

We are now going to proceed with questions, if we may.

I would like to start with Dr. Cook.

Are there lessons that State and Federal wildlife managers can learn from the many years of brucellosis trials when creating a cohesive plan for trying to do what we are trying to do now, with fighting chronic wasting disease, lessons from the one that may apply to the other?

Mr. COOK. Yes, thank you, Chairman Barrasso, for that thoughtful question. I worked on the brucellosis issue for a number of years. It is a frustrating disease, with economic impacts and wildlife impacts as well.

There was a group known as the Greater Yellowstone Interagency Brucellosis Committee which was very successful for a number of years. That group consisted of stakeholders from the Federal Government, both wildlife agencies and agriculture agencies, as well as their State counterparts, and livestock interest organizations, wildlife interest organizations. They worked collaboratively, to borrow the phrase from Ranking Member Carper, they worked cooperatively and collaboratively to achieve some really good successes.

So I think that that kind of shows you, as a role model, the way that one of these committees can work. By including all the stakeholders, by having common ground and common interests, and respecting one another, and working in good faith, they were able to accomplish a number of things.

We also had some funding that was available through that. One of the things that we saw that has occurred with brucellosis more recently is that as funding has declined, some of the interest, particularly at the Federal level, has subsequently also declined. So that GYABC group has basically ceased to exist.

In its place, at the State level, in Wyoming at least, there is a Governor's brucellosis task force, but just consisting of the State interest groups and stakeholders, trying to accomplish more or less the same thing.

Senator BARRASSO. Thank you very much.

Mr. Guertin, fighting wildlife disease your whole life, you have been a long time, dedicated public servant, sometimes necessitates measures that impact the environment. Specifically, spraying for mosquitos to reduce risks to public health of mosquito-borne disease. We have seen that, certainly, in Wyoming. Mitigating environmental impacts is important; so is protecting the public health.

So how does the U.S. Fish and Wildlife Service balance protecting the environment, also protecting humans from wildlife diseases and the insects that then transmit them?

Mr. GUERTIN. Thank you, Mr. Chairman. The Service, first and foremost, works with all of our partners on the landscape to develop a shared vision and a shared, overarching response to get at the root cause of the disease outbreak, and then apply the appropriate treatment as necessary.

There have been cases where the Service, with our partners, has had to use pesticides and other strong tools. With the recent screwworm outbreak in the Florida Keys, for example, like any other partner on the landscape, we have to go through the nec-

essary NEPA requirements, as well as obtain permits. But we worked together to apply the best treatment where necessary and move on.

Senator BARRASSO. Dr. Cook, what are some of the biggest obstacles in getting relevant stakeholders, including the Federal Government, State government, and local governments on the same page when potential pandemics like chronic wasting disease threaten wildlife populations? How do we get everybody working together?

Mr. COOK. Thank you, Chairman. It is my belief that the Federal agencies need to facilitate more and regulate less. They can serve very valuable functions in bringing some of these interest groups together and show some leadership. But again, we need to have all the different interest groups there to give their perspectives. And we need to appreciate and respect the fact that these different interest groups come at these diseases with different values and different concerns, even different beliefs.

So they all need to be represented, we need to choose those leaders that we have representing those interest groups wisely, so that we have respected leaders but also ones that we can depend on to facilitate that communication back to their constituency groups.

Senator BARRASSO. Mr. Guertin, what challenges do you face, U.S. Fish and Wildlife, on the National Wildlife Refuge System, when wildlife diseases encroachment becomes an issue?

Mr. GUERTIN. Thank you, Mr. Chairman. Again, we have to work with all of our partners on the larger landscape to get to the root cause of these. These diseases and these vectors do not recognize the political or planning framework that is in place out there. So we approach them at a larger scale.

We work with all the other partners on the landscape to set priorities, and then we develop either a response plan or a treatment plan. And we have demonstrated that with our efforts to work with the States on chronic wasting disease, under the leadership of the States, working on white-nose syndrome, and some of these outbreaks like fever tick in Texas, or screwworm down in Florida. Shared vision, shared resources, common objective.

Senator BARRASSO. I appreciate all of your comments.

Senator Carper.

Senator CARPER. Thanks again.

I have a question for all of our witnesses, and I will start, if I could, Holly, with you.

As we know, climate change is a major impact in the emergence and spread of wildlife diseases globally. Temperature, rainfall, humidity, and other environmental factors all directly influence the incidence, the spread, and severity of wildlife diseases.

Would you elaborate just a bit, each of you, on your understanding of how climate change affects the incidence or spread of wildlife diseases, and provide maybe an example or two, just very briefly, please?

Holly.

Ms. NIEDERRITER. Thank you. Climate change has the impact to really exacerbate the problem of wildlife disease. Changing temperatures can expand the ranges for pathogens and parasites, it can expand them northward. I can give you specific examples in a minute. One of them already stressed by other factors are more

susceptible to disease, so in cases where the temperature, or there are increased storm events or anything like that, will stress those animals even further, making them also more susceptible to diseases.

Also for animals that are highly mobile, timing and availability of resources can be impacted. There was a study of winter bird counts taken over the past 40 years, and it showed that 22—nearly 20 percent of the species recorded shifted their migration route 100 miles north. When they do that, if their resources don't shift with them, they can get there and not have enough food or not have enough water or not have enough habitat. And that is another avenue for, again, being stressed and having disease take over.

Then there are those species with restricted ranges, like a lot of the species I have worked with, with amphibians and reptiles in particular, which use specific ponds in woodlands and other habitat types. If the drought that is associated with climate change can impact those ponds by either making them smaller and less available, so there are a lot of species that are going to die out right away, and the ones that are left are going to be forced into smaller ponds, and more individuals in a smaller space is a great way for pathogens to be passed among individuals.

Senator CARPER. I'm going to ask you to give just a very few examples and give your fellow witnesses a chance.

OK, thank you very much. For the record, we will want the examples, please.

Dr. Cook, same question, please. Would you elaborate on your understanding of how climate change affects the incidence or spread of wildlife diseases, and maybe provide an example or two? Just very briefly.

Mr. COOK. Yes, thank you, Ranking Member Carper, and Chairman Barrasso.

I will start off by saying I am not a climatologist. This is not my area of expertise. But let me say that the diseases that I talked about, at least, are all infectious diseases. They are caused by an agent. And that is regardless of climate change, that won't change.

We may see, as was previously mentioned, a change in the distribution of disease. So for example, with the chytrid fungus, we know that that fungus has an ideal temperature requirement. So as climate change occurs, you may see areas that previously didn't have that correct temperature now consequently do, so we may see the chytrid spreading into those areas that hadn't been previously impacted.

Conversely, though, you may see that as other areas get too warm for the chytrid fungus, it may die out from other areas. Those are things I really can't predict, but that is a possibility.

As somebody else mentioned, the role of stress, and when I think about the bighorn sheep pneumonia issues, I don't think that climate change will directly increase or decrease the spread or the transmission of that disease. But what could happen, bighorn sheep live in fragile environments, environments that don't necessarily have adequate nutrition all the time. And climate change could stress those environments even more to where there is less nutrition available, and clearly, an animal that has less nutrition

is going to be less capable of fighting off any kind of infectious agents.

Senator CARPER. All right, thanks, Dr. Cook.

Mr. Guertin, same question, please.

Mr. GUERTIN. Thank you, Senator. As a land management agency, we look a lot at our operations, we look at lot at our land management planning. We are evaluating a lot of stressors on the landscape, fire, drought, disease, invasive species, and climatic changes that we are observing out there. Our job is to see how the species and our response to those challenges and then design resilient landscapes for the future and design proactive management strategies to safeguard these natural resources.

Senator CARPER. All right, thanks. My hope is we will have a chance to ask maybe one other question of you in the second round. We will see.

Thank you very much.

Senator BARRASSO. Senator Braun.

Senator BRAUN. Thank you, Mr. Chair. I have been a manager of timberland for a long time, and didn't appreciate invasive species until we are now contending with it in probably a way that doesn't have the significance and seriousness behind it, because it isn't dealing with a live animal or a human being.

But what I have seen in the last 15 years from the emerald ash bore almost completely wiping out the ash population, hoping that there is going to be some resistance there, and there might be. But basically the end result has been, we have lost all of our ash trees. I look at the most venomous of all the invasives, Japanese stiltgrass, that looks like a regular weed growing in the woods. Most people have no idea that it will suffocate all regeneration.

So there is no doubt about it, and I am sure climate is involved. It is mostly the fact that we are such an interconnected world that the isolation that kept us from having all these issues, that is gone. So we don't know what the solutions are going to be for our forests. Basically no idea, other than it is geometrically exploding across that context.

Chronic wasting disease, which to me is one of the things that, due to the nature of the disease, of course, we want to be absolutely certain and know if that can ever hop from a deer to a human being. So far, looks like maybe not.

But I want to focus in on it, because as an owner of timber ground, that is one of our biggest sources of income, leasing hunting rights to mostly deer hunters. I know it is on the doorstep of Indiana.

I will start with you, Mr. Guertin, then we will go across the panel. How serious is it, in the sense of, have we had any tools that have worked, and what can we do through conservation groups, hunting groups, to get the word out that it is potentially going to be a deal breaker for deer hunters?

Mr. GUERTIN. Thank you for your question, Senator. Unfortunately, at this point, there is no cure or treatment available. We are focused primarily on halting the spread of the disease and containing it where found. We have very aggressive strategies in place, in partnership with our States who are the lead on this. We work very closely with the outdoor recreation industry, with the hunting

community, to get the word out. There are a number of protocols that have been established, including test tools and things like that.

But our real strategy is one of containment and eradication if need be.

Senator BRAUN. We tried that on the emerald ash bore, and sooner or later it just cascaded into all forests.

Dr. Cook, can you explain to us here, when you do have it, does it completely wipe out a deer herd? Do some survive it? Has there been any indication of any type of immunity from within the herd?

Mr. COOK. Thank you, Senator Braun, Chairman Barrasso. That is actually an excellent question.

As far as we know, all cervids, all deer species are susceptible to chronic wasting disease. We haven't found a subtype that is immune. There are some genotypes, animals with certain genetic makeup, that have a degree of resistance, in that it takes them longer to develop disease. Once they have the disease, they live longer with it, but they ultimately do die of it. There isn't a true resistant form out there that we have identified at this point, anyway.

One of the things that is really concerning about chronic wasting disease is that when it gets into the environment, once the environment becomes contaminated, it is basically there forever. At least we haven't discovered any ways to clean up the environment. So that is one of the things that is really concerning about it.

What is interesting to me is that, as I have mentioned, we have noticed some populations that are clearly impacted where the population levels are going down because of chronic wasting disease. Yet there are other populations where that has not occurred. And we don't know why that is. I think one of the keys to really understanding this disease is understanding why it seems to increase in prevalence in certain environments and not so much in others. Because that would be our first step in trying to predict where it is going to go, and maybe getting a handle on trying to control it.

Senator BRAUN. What is a host, when it survives in the ground or whatever, is it just there? Or does it have to—is it parasitic on something to where it would then reinfect a revived deer herd?

Mr. COOK. Excellent question, Senator Braun. The prion basically exists on its own. So we know the prions are shed in saliva, urine, and feces. They also accumulate in the brain and spinal cord of an animal. So when an animal dies of CWD, as that animal disintegrates, deteriorates over time, those prions are released as that body decomposes and then contaminate the soil. They exist in the soil, essentially perpetually.

Senator BRAUN. Wow. Thank you.

And real quickly, Holly, is there any connection between chronic wasting disease and climate change, that you are aware of?

Ms. NIEDERRITER. The chronic wasting disease is not a disease that I know much of anything about. I am also not a climatologist, but I don't know of any particular connection for that one.

Senator BRAUN. Thank you.

Ms. NIEDERRITER. Some other deer diseases, though.

Senator BARRASSO. Senator Boozman.

Senator BOOZMAN. Thank you, Mr. Chairman. Thank you and Senator Carper for holding this hearing today.

This really is a big deal for our State and so many States throughout the country. In fact, I think we have 700,000 hunters and anglers in Arkansas that create 25,000 jobs, billion dollars in income, which again, much of that money is put back into conservation. So it is something that is not only good for the economy, but it is great for trying to protect the species that we are talking about.

Mr. Guertin, in regard to that, a billion dollars is very important to the State. I guess what I would like to do is for you to comment on the economic impact that you see.

Mr. GUERTIN. Thank you for your question, Senator. We are seeing a lot of concern in the outdoor recreation economy, in the sport hunting community in particular. People make policy choices, whether they want to invest in a big hunt, buy arms, equipment, hotels, et cetera.

We are doing a lot of proactive work with the State fish and game agencies and others to make sure people know it is still safe to hunt. There are some questions with CDC and others about whether this will be transmitted to humans or not. And many people wait to get their carcass tested. But for us, it will be a lot of education, outreach, and keeping alive the American tradition of sport hunting through the support we can offer.

Senator BOOZMAN. Very good. I think in Arkansas we have had 619 positive cases. Some of the things that the Arkansas game and fish has done is come up with innovative ways, the drop boxes, so that you can test elk and deer. Last year, I believe they tested 1,400 samples. This season they plan to install at least one drop box in every county.

Are there things like that that your agency is doing that you have come up with, some innovative ideas to address the problem?

Mr. GUERTIN. Senator, a lot of the testing is under the auspices of the State fish and game agencies. They are deploying some very innovative solutions, they get some test kit responses very quickly, while people wait, whether or not they can have that animal processed there.

The Fish and Wildlife Service provides a lot of technical capacity and funding through various grant programs that support those State efforts. And we will continue to do everything we can to support our colleagues in the State fish and game agencies and the larger hunting community to get quick results back.

Senator BOOZMAN. I mentioned conservation, which is so, so, very important. According to a recent study by the Association of Fish and Wildlife Agencies, an estimated 58.8 percent, or $3.3 billion of conservation funds to State wildlife agencies came from hunting and fishing related activities, either directly through sale of licenses, tags, stamps, or indirectly through Federal excise taxes on hunting, recreational shooting, and angling equipment.

Again, talk to us a little bit about the synergy between those two, regarding conservation, which is so, so, very important.

Mr. GUERTIN. Thank you for your question, Senator. The U.S. Fish and Wildlife Service is proud to stand shoulder to shoulder with our colleagues in the State fish and game agencies. We work

with them under the umbrella organization of the Association of Fish and Wildlife Agencies to align our priorities, to align our capacity. We all are here to serve the American people and make sure we have sustainable populations of wildlife for generations to come.

Key to that is, of course, the outdoor recreation industry. Another key driver for us is the larger conservation mission. So the Service provides a lot of grant funding and capacity, as do the States, to share the common objective of conservation to benefit the generations to come.

Senator BOOZMAN. And also, Senator Barrasso, I want to thank you that we are a co-sponsor of your bill concerning chronic wasting. I know that what that does is make it such that when completed, the study would give the State wildlife agencies and wildlife experts better information to conduct targeted research on how the disease is transmitted, and determine which areas are most at risk, and develop consistent advice for hunters to prevent further spread.

That to me—and certainly as a physician, you are certainly aware of the importance of getting good information out there. Two, going to the cause. So again, give yourself a pat. We appreciate it.

Senator BARRASSO. I am just grateful for your partnership in this, and your cooperation, and being willing to lend your name and support to this bill. Thank you for all your help.

Senator BOOZMAN. Well, thank you all, and again, thank you all for your hard work in fighting these things. The way that you can help us is as you think of things that we can be better supportive, in the areas that you are working on, be sure, and let us know. The nice thing about this is it is not a Republican or Democrat thing. It is something that the entire country is interested in, and we are interested in doing. Like I said, that is how you can support us and help us. Thank you.

Senator BARRASSO. Thanks, Senator Boozman.

Senator Carper, you had an additional question.

Senator CARPER. I do. I understand Senator Gillibrand is close by, and if she walks in, I will just yield back to her and then pick up my time after she is finished.

Very briefly, from each of you, give us one piece of advice—we think you all agree that you would really like to—in the Navy we call it like a foot stomping kind of deal, maybe in the Marines and Army as well, our instructors in our training, if they had something they really wanted us to remember for the test, they'd stomp their feet. And that was something we should write down.

But in terms of advice you think you all agree on, what would be something you think you would really want us to take home?

Do you want to go first, Mr. Guertin?

Mr. GUERTIN. Thank you, Senator. The key, unifying theme for all of us is the collaborative nature, the partnership nature, the all hands on deck nature of the response. The Fish and Wildlife Service is one entity among many. We are proud to partner with the States, academia, the NGOs, the other Federal agencies, to develop a common mission, and all of us deploy our resources as a priority against getting ahead of these wildlife diseases, so we can ensure

wildlife and fisheries resources for the continuing benefit of the American people.

Senator CARPER. All right, thank you.

Same question, Dr. Cook.

Mr. COOK. Yes, thank you, Ranking Member Carper. Coming from a university perspective, I have to put in a plug for more funding for research, of course. But I think this is another good example of the cooperation and collaboration, the idea of a task force that is overseeing this to provide direction.

As I mentioned, one of my concerns is that a lot of wildlife disease research that is ongoing is very esoteric and not very practical. By having a working group that is overseeing this, that has stakeholders, that provides some direction on where that research ought to go, they can make sure that that research that is being conducted has management implications, will actually help wildlife managers in making their decisions on how to manage not just chronic wasting disease, but others as well.

Senator CARPER. Thank you.

Holly, same question, very briefly, please.

Ms. NIEDERRITER. My answer is pretty much the same as theirs. That collaborative effort is what is really needed, and having a central—one central entity that can oversee all of that. That helps keep repetition from happening, it really helps focus on specific, the most important aspects of it. In the case of white-nose syndrome, and in the case of Bsal, which is a salamander disease that is happening, there is a central group of people who came up with a specific plan, with really good guidelines for how to move forward. I think that really does help the States, it helps us focus on those things.

But funding really does have to be a part of it as well, especially to States.

Senator CARPER. Thank you.

I reserve the balance of my time and yield to Senator Gillibrand.

Senator GILLIBRAND. Thank you, Mr. Chairman, Mr. Ranking Member, for the hearing.

Lyme disease is a serious problem in New York and across the country. The Cary Institute of Ecosystem Studies estimated that more than 400,000 people are diagnosed with Lyme disease in the United States each year. And this number is increasing rapidly due to a number of factors, including climate change.

According to Centers for Disease Control and Prevention, New York is one of the top States in the country for reported cases of Lyme disease. Lyme disease is transmitted to humans by deer ticks, and can have debilitating and life long health effects.

Mr. Guertin, what can Fish and Wildlife Service do to help States and localities address the prevalence of Lyme disease?

Mr. GUERTIN. Thank you for your question, Senator.

The Fish and Wildlife Service can provide a lot of technical assistance. We can provide grant funding to our colleagues in the State fish and game agencies. A lot of the management authority for whitetail deer is vested with our colleagues in the State fish and game agencies. So in this space, we are more of a technical assistance provider and can help in a larger outreach and education and eradication campaign, coordination, so to speak.

Senator GILLIBRAND. Thank you.

Ms. Niederriter, can you talk about the impacts that climate change is having on the habitat and range of deer ticks and what effect that could have on the spread of Lyme disease in the United States?

Ms. NIEDERRITER. I don't really know the answer to that specifically. But I would expect, and it certainly has been the case with some tick species and some animals that are being impacted by them, that as the climate warms, and it gets warmer in places that weren't warm before, more ticks—ticks are active when it is warm out. And they thrive in warmer climates, so they are most likely to be a worse problem, based on what we know about climate change and ticks.

Senator GILLIBRAND. Would you do some research for me and submit a letter to the committee with a fuller answer on that question?

Ms. NIEDERRITER. Yes.

Senator GILLIBRAND. Thank you.

Are there any additional resources that States need to address the factors that contribute to the spread of Lyme disease, in your opinion?

Ms. NIEDERRITER. Would you repeat the question?

Senator GILLIBRAND. Are there additional resources that States need to address the factors that contribute to the spread of Lyme disease?

Ms. NIEDERRITER. I am sure that they could use more funding to look at that. I know in Delaware, we recently hired a biologist who is focusing mostly on ticks. So that is a huge help, and I am not sure where the funding came from for that. But if each State had that, and there was like a central overseer to help collaborate all that information, that would be helpful.

Senator GILLIBRAND. Interesting.

I want to move now to salamander disease. Ms. Niederriter, in your testimony, you mentioned Bsal, a fungal disease that is currently devastating salamanders in Europe. Fortunately, this disease has not yet made it to the United States.

A few weeks ago, I received a letter from a 5 year old constituent of mine named Earl, who wrote to ask that I help salamanders, his favorite animal. Here is the letter; I ask unanimous consent to submit the letter and his parents' letter into the record.

Senator BARRASSO. From a 5 year old, absolutely, there is no objection.

[The referenced information was not received at time of print.]

Senator GILLIBRAND. Thank you.

So I would like to ask you what we can do to help prevent the spread of Bsal to the United States. As I am sure you are aware, the U.S. Fish and Wildlife Service established the North American Bsal Task Force in 2015. Acting on recommendations from the task force, the Fish and Wildlife Service banned the importation of 201 different species of salamander.

However, recent reports in scientific literature show that many species of frogs, toads, and newts may carry Bsal without any signs of infection. Should the work of the task force be restarted to consider further restrictions on imported amphibians?

Ms. NIEDERRITER. To answer that very shortly, yes. I do think that that would be a helpful thing to do for sure. And additional research into how the disease can be transmitted between those different species. I know there is research going on right now looking at specific species that are likely to carry it and to have it. But restricting the disease from getting in is priority one right now.

Senator GILLIBRAND. What can we as the committee do to ensure that the task force takes a more active posture in surveillance and response to Bsal?

Ms. NIEDERRITER. I am not sure how the committees really work and at what level they can work. But I would think that reaching out to the individual States and to the task force would be helpful.

Senator GILLIBRAND. OK. And would additional resources for the partners in amphibian and reptile conservation, or the regional State wildlife grants, be an option for preventing Bsal introduction?

Ms. NIEDERRITER. Can you repeat that question? I'm sorry.

Senator GILLIBRAND. More money, would that be helpful?

Ms. NIEDERRITER. Yes, absolutely. Always.

[Laughter.]

Senator BARRASSO. All three members have testified to that effect already.

Senator GILLIBRAND. That is always a good idea.

Mr. Guertin, some of the current—this is now moving to honeybees—oh, I am out of time.

Mr. Guertin, I would like to submit two questions for the record for you on the colony collapse disorder and other things affecting our honeybees.

Mr. GUERTIN. We would be glad to respond for the record. Thank you, Senator.

Senator GILLIBRAND. Thank you.

Thank you again, Mr. Chairman.

Senator BARRASSO. And Dr. Cook, as an academician, also requested additional funding.

Senator GILLIBRAND. Excellent. More experts.

Senator BARRASSO. Senator Carper.

Senator CARPER. Thanks very much.

We are expected to know, as Senators, a little bit about almost everything. I like to say, a mile wide and an inch deep. Some issues, some areas we are expected to know more.

For those of us on this committee, we focus on a lot of environmental issues, and a lot of infrastructure, transportation and infrastructure issues. The Chairman is going to from here to the Foreign Relations Committee. So he is expected to know a whole lot more about that, and more in depth.

I know in your job, I suspect in your job, Mr. Guertin, you are expected to have a whole lot of information about a lot of stuff in the area of your jurisdiction. What I would just ask from each of you, how important would you say—and we will start with you, Holly—how important would you say is a director's expertise in wildlife management and wildlife laws in addressing wildlife disease and other complex wildlife challenges? How important is that?

Ms. NIEDERRITER. How important is their——

Senator CARPER. How important is a director's expertise in wildlife management and wildlife laws in addressing wildlife disease and other complex wildlife challenges? How important is it?

Ms. NIEDERRITER. I think it is very important, because understanding them is really the first step in how to address any of the issues that occur.

Senator CARPER. All right, thank you.

Dr. Cook, any thoughts?

Mr. COOK. Yes, I would agree, thank you, Senator Carper, for the question. I would agree that it is important. I think they have to have the 30,000 foot view. We can't expect them to be completely up to date on all the intricate details, but certainly to understand the broad implications of disease management. I would consider that to be important, yes, sir.

Senator CARPER. All right.

Mr. Guertin, any thoughts?

Mr. GUERTIN. Thank you for your question, Senator. In the Federal agencies, for the executive level positions, we are also looking at the executive core qualifications, leading change, leading people, these executive functioning skills, leadership communications, project management, as well as the technical credentials of the leadership cadre.

Senator CARPER. Thanks.

One last question, if I could, Mr. Guertin, dealing with threatened and endangered species. While wildlife disease presents a serious threat to all species, it can be particularly dangerous for threatened and endangered species, as you know. These species are especially vulnerable to disease, because they have small population sizes, lower genetic diversity, and they are already stressed by factors like habitat loss, invasive species, and pollution.

To what extent is disease a barrier to the Service's implementation of the Endangered Species Act, and how does disease factor into the Service's ability to recover threatened and endangered species?

Mr. GUERTIN. Thank you for your question, Senator. When the U.S. Fish and Wildlife Service makes an evaluation, a listing determination of any species, we base it solely on the best available scientific information, and we use what is called a five factor analysis. We evaluate five prevailing conditions. They include present or perceived destruction of habitat, it includes disease or predation, it involves over-utilization for commercial or other purposes, it involves the status of existing regulatory mechanisms, and then any other man made factors that would affect its survival.

So disease is one of the big five that we use to make any potential determination for Federal protection under the Endangered Species Act.

Senator CARPER. OK, thank you.

Thank you all.

Senator BARRASSO. Senator Cardin.

Senator CARDIN. Let me thank all of you for your service, and for your being here today.

I just want to make a point about how we need to deal with our environment as it relates to the spread of diseases. When you look at the success that we had on the Eastern Shore of Maryland, on

the DelMarVa Peninsula fox squirrel, which was listed as an endangered species, it is now off, it was habitat loss that was the major culprit for the endangerment of that species.

So as we are looking at challenges today, and I look at my own State, look at the Chesapeake Bay watershed, the restoration of wetlands is critically important for many, many reasons. One reason is that it protects our species. Climate change has made it more challenging, because we are now facing different challenges than we did before.

So what type of strategy can we deploy to sensitize our efforts in these areas, recognizing that the health of the species are very much at stake? How can we do a better job in education, and in practical ways that we can help restore habitat to protect species?

Mr. GUERTIN. Thank you for your question, Senator. The Fish and Wildlife Service, first and foremost, wants to develop a shared vision with all the stakeholders on the landscape we operate in, starting with our colleagues in the local fish and wildlife agency, as well as other primary landowners who have management authority in that area.

We then try to work to develop a common vision for conservation, working landscapes. We then try to bring the tools we can to bear, there are a variety of things, there is our Partners for Fish and Wildlife program, that does a lot of work with private landowners on habitat restoration for priority and trust species.

We can provide a lot of technical assistance, fish passage and other things. And then the Secretary of Interior has a number of conservation programs, including the North American Waterfowl Conservation Fund, the LWCF and others. We can prioritize conservation easement overlays, in some cases, fee title. A variety of tools to deploy in a chosen project area, so to speak, to focus on a larger conservation outcome while balancing that with other uses of the land.

Senator CARDIN. One thing I would point out is that we found the success of the Chesapeake Bay program was because the public understands it. They get it, they understand that what they do, how they handle the runoff, how they handle their farming practices, how we handle development, how we handle treatment of waste, all have a major impact on the quality of the Chesapeake Bay.

I am not sure we have done the same degree of educating the public as protection of species in this regard. Can we be more effective in the way that we engage the public as the importance of these programs in regard to the health of species?

Mr. GUERTIN. Certainly, Senator. The Chesapeake Bay and all the partners there are really a beacon for conservation for the rest of the country, all the work that the State of Maryland, Delaware, Virginia have done, the Federal partners, unifying around a lot of larger objectives, balancing recreational and commercial fishing, balancing against invasive species control, such as nutria eradication, and then using the necklace of wildlife refuges and other lands.

And the big partnership with private landowners and people have rallied around some of the big species, striped bass, waterfowl, and others, as iconic to represent the needs of that area. We

can certainly replicate that type of success story in other parts of the country to demonstrate the value of a balanced approach to species conservation while Americans make a living on the same landscape.

Senator CARDIN. I will look forward to working with you on that. I am out frequently with your people in the community. It is great, I just don't see us concentrating as much, I think, on this area as we should. So I think we should look for opportunities to enhance these areas.

Mr. GUERTIN. Thank you, Senator. We would welcome the opportunity to work further with you and develop that common vision and move forward to implement with our State partners.

Senator CARDIN. Thank you.

Thank you, Mr. Chairman.

Senator BARRASSO. Thank you, Senator Cardin.

Senator Carper.

Senator CARPER. Mr. Chairman, I have no letters from 5 year olds, but I do have a unanimous consent request to enter into the record additional written testimony from stakeholders impacted by the spread of wildlife disease. And just as a P.S., the value of agriculture in our State's economy is about $8 billion a year, $8 billion, which is a lot of money for a little State.

And people say to me, why do we care about the brown bat, why should it be that important. And I say, agriculture is our No. 1 industry, tourism close, No. 2. It is important we have those bats, because they are eating mosquitos and a lot of other things that help us as tourists and make Delaware more attractive, and help our farmers be more successful and profitable. Thank you.

[The referenced information follows:]

STATEMENT OF THE BOONE AND CROCKETT CLUB
For the record in the Senate Environment and Public Works Committee,
Legislative Hearing on
Examining the Impacts of Disease on Wildlife Conservation and Management
October 16, 2019

Dear Senators Barrasso and Carper:

Thank you for turning the committee's attention to the problem of wildlife disease. The Federal government's assistance to state wildlife managers in combating Chronic Wasting Disease has been highly valuable through the active assistance of the US Geological Survey. CWD is an ominous problem that is actively spreading across North America.

As Senator Barrasso, several committee members, and many bipartisan cosponsors attested by proposing S. 382, the Chronic Wasting Disease Transmission in Cervidae Study Act, this disease is a priority problem in wildlife conservation today.

This contagious neurological disorder already poses a serious threat to wildlife populations. It appears that CWD has steadily worsened since its initial discovery in a mule deer herd at a Colorado research facility in the late 1960s. It's now been identified in 26 states – including Wyoming, South Dakota, Indiana, Iowa, Maryland, and Arkansas – and three Canadian provinces.

Many challenges must be overcome. CWD is 100% fatal, takes a long time post-infection to cause identifiable symptoms, and is caused by a disease agent – a form of protein called a prion – that is extremely persistent in soil and other natural materials, therefore remaining a hazard for new infections over a long period. The only means of control at this point is significant culling of the infected population. Better understanding of transmission will inform the development of better precautionary and new predictive measures.

We have partnered with several other organizations to fund complementary research projects focused on responses to outbreaks and better means of detecting of the prion disease agent. Among our priorities for research are developing a faster, more effective test. Ideally, we hope to develop a test for live animals, for which no practical method exists because the only conclusive diagnosis involves an examination of the brain, tonsils or lymph nodes performed after death. On these and other studies we are engaged with the deer farming industry, which shares the risk of CWD to deer and elk.

We look forward to working with the committee on sustaining and expanding Federal support of state efforts.

PO BOX 9257
MISSOULA, MT 59807
406-926-1908

October 15, 2019

The Honorable John Barrasso
Chairman
Senate Environment and Public Works Committee
410 Dirksen Senate Office Building
Washington, D.C. 20510

The Honorable Thomas Carper
Ranking Member
Senate Environment and Public Works Committee
456 Senate Dirksen Office Building
Washington, D.C. 20510

Testimony of Backcountry Hunters & Anglers on wildlife diseases, including Chronic Wasting Disease, for the Senate Environment and Public Works Committee

Point of Contact: Julia Peebles
Email: peebles@backcountryhunters.org

Dear Chairman Barrasso and Ranking Member Carper:

The North Dakota Chapter of Backcountry Hunters & Anglers (BHA) is part of the fastest growing conservation organization in North American. Together, we represent the voices of over 40,000 members with dedicated sportsmen and women committed to speaking up on behalf of our wild public lands, waters, and wildlife. Over the past six years, BHA has doubled its membership annually and 69 percent of those sportsmen and women are between the ages 18 and 45 years old. More than half of our members identify as Independent or unaffiliated with 25 percent as Republican and 16 percent as Democrat. Established in 2018, North Dakota BHA has quadrupled our membership in just over a year and we represent hunters and anglers across the entire state.

We write regarding the hearing on wildlife diseases, including Chronic Wasting Disease (CWD). First discovered in 1967 in captive mule deer in Colorado, CWD is a transmissible spongiform encephalopathy (TSE) prion disease found in cervid populations (i.e. deer, elk and moose). The first case of CWD in wild cervids was documented in 1981 in a wild elk in Colorado. CWD is now found in 26 states, three Canadian provinces, Norway and South Korea.

CWD poses a legitimate threat to the future of hunting and conservation in North America. Studies have shown that in areas where CWD is endemic, the disease may be a population-limiting factor and could lead to local population collapse and extinction in those regions.

According to the Department of Agribusiness and Applied Economics at North Dakota State University, Hunting and Angling represents a $2.1-billion economy in North Dakota. But, to North Dakotans, it's more than the economic impact, it's the annual traditions and family gatherings that we build around this outdoor heritage.

On a national scale, the 2016 National Survey of Fishing, Hunting, and Wildlife Associated Recreation reports that 8.1 million hunters participated in deer hunting, while 712,000 hunters pursued elk. This outdoor industry is responsible for contributing nearly $40 billion annually to the Nation's economy. Cervids, specifically deer, are the most pursued species in North America. The potential loss of populations paired with already declining hunter numbers throughout North America places the North American Model of Wildlife Conservation itself at risk. As an organization comprised of hunters and anglers, BHA cannot sit idly by as CWD threatens the future of hunting, cervid populations, and funding mechanisms utilized to manage our public lands, waters, and wildlife.

We commend the Committee for discussing this important issue and encourage you to consider the following five principles adopted by all BHA chapters in North America:

1. Education and engagement of the hunting community in the fight against CWD including, but not limited to, best practices for hunters in a CWD prevalent area, background information on CWD, current and consistent research and data findings, up-to-date management agency websites, and regulations;
2. Research of disease epidemiology, management techniques, human dimension issues, and economic analysis of CWD to economies and stakeholders (including wildlife management agencies);
3. Coordination between neighboring state, provincial, tribal and territorial wildlife agencies to ensure effective management and regulatory responses to CWD at the regional level;
4. Dedicated funding to combat CWD through, but not limited to, research, testing, surveillance, carcass disposal, education, and programs to increase hunter compliance;
5. The continued hunting of cervids in CWD positive areas, where appropriate, to keep population densities at optimum levels to minimize the spread of CWD.

Following these sportsmen principles could contain the spread of CWD in North America and lead to the implementation of new solutions for addressing its impacts effectively.

Thank you for the opportunity to submit testimony for the record. We appreciate your consideration of our recommendations and encourage you to follow BHA's sportsmen principles to safeguard the future of hunting opportunities in North America.

Sincerely,

Brock Wahl
Chairman
North Dakota Chapter of Backcountry Hunters & Anglers

WWW.BACKCOUNTRYHUNTERS.ORG
ADMIN@BACKCOUNTRYHUNTERS.ORG
725 W ALDER SUITE 11
MISSOULA, MT 59802

STATEMENT OF GRAY N. THORNTON of THE WILD SHEEP FOUNDATION
For the record in the Senate Environment and Public Works Committee,
Legislative Hearing on
Examining the Impacts of Disease on Wildlife Conservation and Management
October 16, 2019

Dear Senators Barrasso and Carper:

As President and CEO of the Wild Sheep Foundation, I thank you for holding this hearing. Pneumonia is the primary obstacle to restoration of bighorn sheep. The U.S. Fish and Wildlife Service system of National Wildlife Refuges is central to the defense and restoration of wild sheep herds against pneumonia.

Like many species of big game, bighorn sheep in North America fell to perilously low numbers around the year 1900. By the mid-1950s, fewer than 17,000 bighorns occurred in the West, with another 8,000 in Canada and Mexico. Since then, nearly 23,000 animals have been translocated in 22 wild sheep jurisdictions in the U.S., Canada, and Mexico, in approximately 1,550 separate translocations. These translocations, when combined with other management efforts, have restored bighorn numbers to more than 85,000 in the U.S., Canada, and Mexico.

The benefits of many translocations have been erased by outbreaks of disease. Two populations - Sierra Nevada bighorn sheep and peninsular bighorn sheep are listed as Endangered Species under the Endangered Species Act. Many more - including those on National Wildlife Refuges - are struggling to grow as they repeatedly suffer from outbreaks of disease.

Die-offs – disease outbreaks that are caused by bacteria – attack all age classes and on average result in the loss of 40% of a herd. Some of the surviving sheep may become chronic shedders of the bacteria. This has led to two devastating outcomes: 1) lambs born healthy that succumb to pneumonia within the first months of life, eliminate herd growth which leads to dwindling populations; and, 2) chronic shedders that encounter uninfected sheep in adjacent herds which can lead to a die-off in that herd. Surviving bighorns may develop immunity to the strain of bacteria that caused the first die-off but have no immunity to subsequent strains. Herds that do not recover pose a continuing risk and have been euthanized to clear the way for the expensive effort of repopulating the herd with healthy animals from other areas.

The only proven strategy to prevent this problem is to keep wild sheep separate from domestic sheep. Domestic sheep were the original source of the bacteria and carry them with little to no impact to their health.

To overcome the problem, translocation is necessary to rebuild bighorn herds, which requires sources of healthy wild sheep herds providing surplus animals for movement. National Wildlife Refuges such as The Desert National Wildlife Refuge in Nevada are free of domestic sheep and provide such safe areas for wild sheep populations This year, the Air Force proposed to

eliminate 75% of the Desert National Wildlife Refuge. Loss of the Refuge, established in 1934 for bighorn sheep conservation, would be the largest reduction in the National Wildlife Refuge System in history, and a crippling loss to efforts to manage and restore bighorn sheep west wide.

The Wild Sheep Foundation raises private funding for restoration of wild sheep via trap-and-translocate and other fieldwork to repopulate suitable bighorn sheep habitat. Combatting pneumonia is our primary objective. We fund research on the disease and invest in willing-party buy-outs and retirements of domestic sheep grazing allotments to separate bighorn and domestic sheep. WSF endowed the Rocky Crate/Wild Sheep Foundation Endowed Chair for Wild Sheep Disease Research at Washington State University. We have directed $130 million towards wild sheep conservation in our 45-year history, and WSF annually generates 40% of the revenue required for state and provincial wild sheep conservation and management.

Thank you again for your attention to wildlife disease. Please call on the Wild Sheep Foundation for help in managing this problem.

Black-footed Ferret Friends
Chair, John Emmerich
8517 Pharmond Trail
Cheyenne, Wyoming 82009
(307) 421-0570

STATEMENT FOR THE RECORD

BY THE UNDERSIGNED PARTNERS WORKING CLOSELY WITH STATE AND FEDERAL AGENCIES INVOLVED IN THE RECOVERY OF THE ENDANGERED BLACK-FOOTED FERRET

FOR THE SENATE COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS HEARING ENTITLED

"Examining the Impacts of Diseases on Wildlife Conservation and Management"

WEDNESDAY, OCTOBER 16, 2019

Chairman Barrasso, Ranking Member Carper, and members of the committee, thank you for the opportunity to provide a written statement concerning the impacts of diseases on wildlife conservation and management from the non-government partners working with various Federal and State Agencies to recover the endangered black-footed ferret (ferret).

The people of the United States, and the natural resources on which they depend for their health and livelihoods, must be protected from foreign, invasive diseases associated with wildlife that threaten their health and jobs. Prominent among these types of diseases is sylvatic plague (plague) which is caused by the bacterium *Yersinia pestis*. It first arrived in the North America in the San Francisco Bay area about 1900 carried by fleas on rats aboard ships from the Orient. The entrance of plague has caused human deaths, but also established the disease in rodent populations across the western United States.

Issues to address

Plague is responsible for several human deaths annually in the western United States; it sickens many others and may become more of a threat in the future. Both rural and urban areas are impacted, but especially ranching and farming operations are at risk of exposure. Fortunately, it is treatable with antibiotics if diagnosed in a timely manner.

It is known to devastate some wildlife populations and probably adversely affects many more. Principal among these wildlife species is the endangered black-footed ferret that represents the proverbial "canary in a coal mine" with regard to prairie ecosystems across many states west of the Mississippi River. Sylvatic plague is the key threat to recovery of the ferret. Of the thirty reintroduction sites, only half are still active because of the devastating impact of plague. The sites that are still active are due to active plague mitigation on those sites.

Plague also devastates several prairie dog species on which the ferret relies almost exclusively for food and shelter. Prairie dog conservation in select areas supports endangered species and other at-risk wildlife populations and could prevent future endangered species listings.

Proposed steps to address these issues:

Systematically monitor and proactively manage the occurrence of plague, especially in the western United States. USDA APHIS Wildlife Services is uniquely positioned to address this need with relevant operational capacity in all States. Sufficient funding to address these needs is not currently available, even though approximately50 Private, State, Tribal, and Federal partners have contributed millions of dollars to related wildlife conservation efforts over the past four decades via ferret recovery activities. We recommend increased funding to APHIS Wildlife Services to carry out these activities.

Purposefully manage the location and extent of prairie dog populations in the western United States to conserve both endangered and at-risk species. State Wildlife Agencies, in cooperation with the DOI and the U.S. Fish and Wildlife Service, are uniquely positioned to utilize additional resources to address this need. This would mean conserving prairie dog populations in some areas and limiting them in other areas. We recommend increased funding for DOI to support efforts by the U.S. Fish and Wildlife Service and Bureau of Indian Affairs to carry out these activities in partnership with State Wildlife Agencies.

Utilize ferret recovery to achieve not only the recovery of this species, but also the health of related wildlife ecosystems while ensuring the safety and prosperity of the people who live and work on lands across the western United States.

Thank you for considering these recommendations.

Audubon of Kansas
Apsaalooke Nation, Crow Indian Reservation
Association of Zoos and Aquariums
Black-footed Ferret Friends
Centre for Conservation Research Calgary Zoological Society
Cheyenne River Sioux Tribe
City of Fort Collins, Natural Areas Department
Colorado Cattleman's Association
Defenders of Wildlife
Gros Venture and Assiniboine Tribe, Fort Belknap
Little Dog Wildlife
Lower Brule Sioux Tribe
National Fish and Wildlife Foundation
National Wildlife Federation
Navajo Nation, Fish and Wildlife Department
Northern Cheyenne Department of Environmental Protection and Natural Resources
Prairie Wildlife Research
Rosebud Sioux Tribe
The Nature Conservancy
Turner Endangered Species Fund
Western Landowner Alliance
Wildlife Ecology Institute
World Wildlife Fund

Senator BARRASSO. Thank you, Senator Carper.

I want to thank all the witnesses, thank you for being here, thank you for your exquisite testimony. It was very well received. We appreciate your time answering the questions.

There are no more questions for the panel today, but members may submit questions for the record. The hearing record will therefore stay open for 2 weeks.

We hope that if you receive questions, and I know you have been given a homework assignment by one of the members, if you would please get that in within the amount of time.

I want to thank the witnesses for your time and your testimony.

The hearing is adjourned.

[Whereupon, at 11:20 a.m., the hearing was concluded.]