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Wildlife Disease and its Impact on Wildlife Conservation and Management

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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

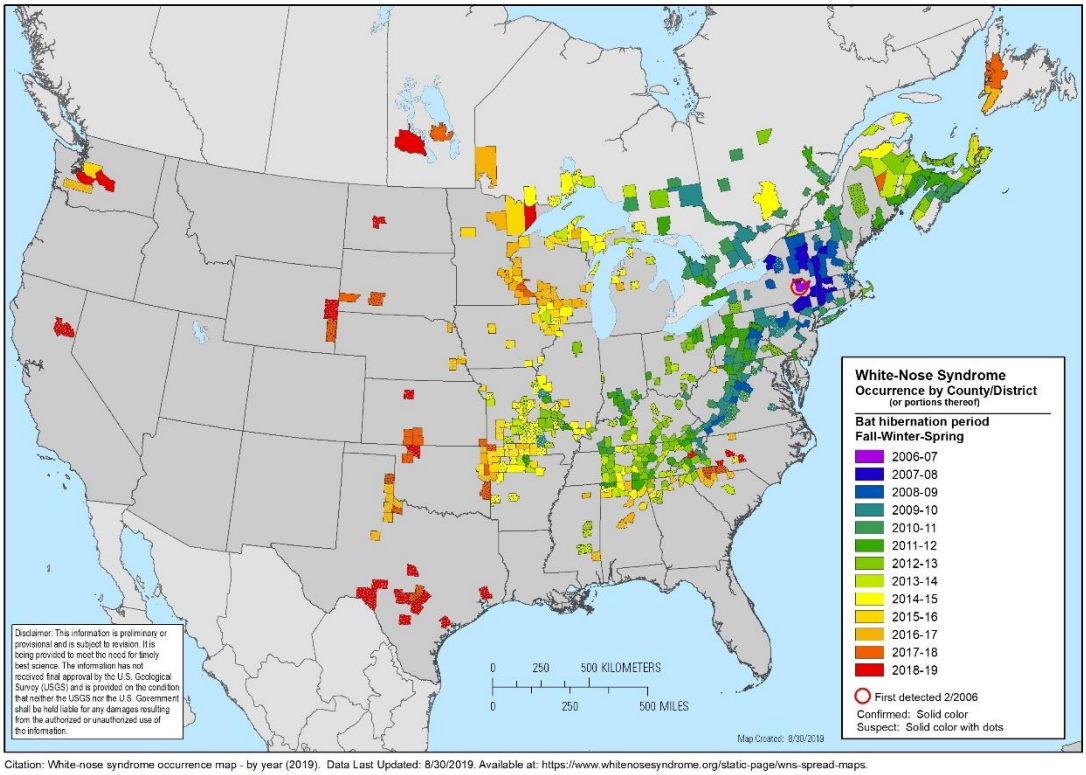
White-nose Syndrome in bats:

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/.