# SCWDS BRIEFS

*A Quarterly Newsletter from the*

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## Screwworm Update

On December 19, 2016, a stray dog from Homestead, Florida, was treated for myiasis consistent with New World screwworm (NWS) infestation. Larvae collected were confirmed as NWS on January 6, 2017, which marked the first confirmed case on the mainland, and the northernmost documentation of the ongoing outbreak first detected in the lower keys in 2016. In response to this case, NWS surveillance, response, and public outreach efforts were initiated or enhanced in the Homestead area.

Also on January 6th, the United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), released a report (*Investigation into Introduction of New World Screwworm into the Florida Keys*) summarizing its official investigation into the 2016 outbreak of NWS in Florida. The report assessed several possible routes through which NWS larvae may have entered Florida in 2016, including international airplane and boat traffic from neighboring NWS-endemic countries. Although a route of introduction was not identified, the report highlights that the "most likely" source was NWS larvae being carried on a human or animal into the United States from an NWS-endemic country. The prospect of an adult fly being transported directly from an NWS-endemic country to the Florida Keys was not investigated due to uncertainties surrounding such an event, including weather, temperature, distance, and host availability.

Current outbreak response activities include fly eradication, surveillance, and collaboration with the USDA's Agricultural Research Service to genotype the collected fly larvae. Determination of the genotype of the fly may shed light on the potential origin and route of entry of NWS into Florida. Eradication efforts continue to utilize the sterile insect technique that involves dispersal of irradiated, sterile male flies. Approximately 104 million sterile flies have been released to date in and around the middle keys and Homestead. Additional releases of sterile flies are scheduled to continue in conjunction with continued surveillance efforts.

To date, the USDA APHIS National Veterinary Services Laboratories (NVSL) has confirmed cases of NWS in five different species from seven areas in the keys and Homestead; however, no new confirmed cases have been reported since January 6, 2017. Combining confirmed and probable cases, 135 Key deer died or were euthanized due to NWS myiasis with many more cases that likely died undetected. Many other confirmed and probable cases underwent treatment and survived. Since January 6, 2017, no Key deer have been treated or euthanized due to NWS myiasis.

As reported in SCWDS BRIEFS (Vol. 32, No. 3), *Screwworm in the Florida Keys,* these cases marked the first of their kind since NWS was eradicated from the United States in the 1950s. The APHIS report suggests that NWS was not present in Florida prior to 2016, and that NWS larvae likely were introduced into the Florida Keys in the spring of that year. The complete report can be found at https://www.aphis.usda.gov/stakeholders/downloads/2017/nws-epi-report.pdf. Suspected cases of NWS myiasis may be reported by calling 1-800-HELP-FLA. (Prepared by John Bryan, Heather Fenton, and Mark Cunningham, [Florida Fish and Wildlife Conservation Commission])

## White-Nose Syndrome, 2017

Researchers in Pennsylvania recently reported a novel double-stranded RNA virus in isolates of *Pseudogymnoascus* (formerly *Geomyces*)

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*destructans* (Pd), the fungus that causes white-nose syndrome (WNS) in bats. The new mycovirus (a virus that infects fungi) was named *Pseudogymnoascus destructans* partitivirus-pa (PdPV-pa), and the authors stated that it could be a promising tool in the study of the WNS epidemiology. They examined 62 Pd isolates and found PdPV-pa in 45/45 North American isolates and in 0/17 European Pd. Phylogenetic analyses of PdPV-pa revealed that viral sequences varied depending on the geographic origin of the Pd isolate: Mycoviruses from the Canadian Pd isolates were in a genetic clade distinct from the PdPV-pa from the USA, and there were clusters of isolates from several individual states within the USA clade. The authors stated that these findings suggest fungal spread followed by local adaption of Pd in different regions of the USA and Canada. Within regions, no differences were found among isolates from different bat species, indicating that Pd is a generalist that is transmitted effectively from species to species.

Other mycoviruses have been shown to elicit phenotypic changes, including hypovirulence and hypervirulence, in the host fungus. This phenomenon has not yet been evaluated with PdPV-pa; however, future investigation of its biological effects in Pd may provide a better understanding of WNS and possibly inform management strategies. The full paper can be found at http://journals.plos.org/plospathogens/article?id=10.1371/journal.ppat.1006076.

White-nose syndrome continues to spread and negatively impact North America's hibernating bat populations. In 2016, WNS was confirmed in Washington state, representing a distant jump to the West Coast from the nearest previously reported cases in the Midwest. Analyses showed that the Pd isolates in Washington were similar to those from the eastern USA and Canada and were unlikely to have originated in Eurasia. White-nose syndrome now has been found in 29 states and five Canadian provinces, and all evidence suggests that Pd was introduced to North America from Eurasia and has spread since 2006 from a point source near Albany, New York. Skin lesions that fit the case definition of WNS, in the absence of large-scale mortality, also have been documented in Eurasia, and the geographical distribution of Pd has been extended to include Austria, Belgium, Czech Republic, Denmark, Estonia, France, Germany, Hungary, the Netherlands, Poland, Romania, Slovakia, Switzerland, Turkey, Ukraine, the United Kingdom, and China.

The physiological mechanisms causing WNS-associated mortality in bats have been studied intensively over the last decade, and a multi-stage disease progression model has been described by University of Wisconsin researchers http://bmcphysiol.biomedcentral.com/articles/10.1186/s12899-014-0010-4. The stages of WNS include initial colonization and invasion of the epidermis that leads to increased energy use and development of metabolic disturbances. As the disease progresses, skin ulcerations develop and are thought to cause increased arousal from torpor. Arousal allows for normalization of certain physiological processes, but results in depletion of energy reserves and accelerated dehydration. Dehydration and resulting low blood volume are believed to stimulate bats to take flights during winter. In its final stages, the cycle of arousal, water loss, electrolyte depletion, and energy consumption continues until the energy reserves are exhausted and mortality occurs.

This devastating fungal disease plagues seven North American bat species, including two endangered species (gray bat [*Myotis grisescens*] and Indiana bat [*Myotis sodalis*]) and one threatened species (northern long-eared bat [*Myotis septentrionalis*]). Steep WNS-associated declines in populations of the little brown bat (*Myotis lucifugus*) and tri-colored bat (*Perimyotis subflavus*) have stimulated discussions regarding the potential need for listing additional bat species as threatened or endangered.

Strategies in place across North America are designed to increase survival rates of remaining bat populations and prevent the spread of Pd to unaffected hibernacula and locations. Some caves have been closed to human traffic when bats are hibernating in order to reduce disturbances. Strict decontamination protocols have been put into effect to prevent human-facilitated geographic spread of the fungus. Everyone, from researchers and biologists to the general public, is strongly encouraged to



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decontaminate their boots, equipment, clothing, and other articles after leaving any cave. Visitors also are discouraged from visiting unaffected caves after visiting affected sites. In many states, field trials are in progress to attract bats to artificial hibernacula that can be decontaminated between hibernation cycles. Researchers continue to explore strategies to combat environmental fungal growth: Everything, from short wave ultraviolet light to volatile organic compounds produced by microbes, is being investigated for its potential to reduce fungal loads in endemic hibernacula.

Despite all of the advances, bats are still declining at alarming rates due to WNS and other environmental changes. Continued public education, engagement, and scientific innovation will be critical to save this diverse and vital part of North American ecosystems from this devastating disease. More information can be found at www.whitenosesyndrome.org. (Prepared by Taylor Pursell from Texas A&M College of Veterinary Medicine and Heather Fenton)

## Avian Influenza Virus, February 2017

Avian influenza virus (AIV) remains prominent in global animal health news. Infection with low pathogenic, AIV H7N2 was confirmed in more than 100 cats in New York City (NYC) animal shelters in mid-December 2016. Infection with this virus caused mild, transient illness in a veterinarian who worked closely with the infected cats. There have been no other human cases reported, despite screening 350 people who may have been exposed. This was the third human case of AIV H7N2 reported in the United States. Cats are susceptible to influenza viruses, including AIV, but cat-to-cat epidemics of this nature are uncommon. However, the recent episode illustrates the potential role that domestic cats could play as intermediate hosts for AIV, and as facilitators of its adaptation to other mammals or transmission to humans.

On the other side of the country, vestiges of a different AIV continue to surface. Highly pathogenic avian influenza virus (HPAIV) was detected in a hunter-harvested mallard in Montana in December 2016. This is the second detection of H5N2 HPAIV containing the Eurasian-origin, Group A clade 2.3.4.4 hemagglutinin (H) in North America in the past five months. Viruses with this hemagglutinin first were detected in North America in wild birds in December 2014. They eventually caused the largest HPAIV outbreak in domestic poultry in United States history. Through extensive eradication efforts, the outbreak was under control in North America by June 2015. Subsequent surveillance in wild birds failed to detect any clade 2.3.4.4 H5 viruses until this past August (SCWDS BRIEFS, Vol. 32, No. 3). The two detections were made via molecular diagnostic techniques and are difficult to interpret regarding potential long-term establishment of the clade 2.3.4.4 H5 in North America. This is especially true in relation to the very low detection rate compared to North American LPAI viruses (including LPAI H5 viruses) and the failure to actually isolate a HPAI AIV from North American wild birds since 2015.

In contrast to the situation in North America, the clade 2.3.4.4 H5 viruses are highly active in Eurasia. Highly pathogenic H5N8 viruses were detected in wild birds on the Mongolian border of Russia in May 2016, and now are causing widespread mortality events in domestic poultry and numerous species of wild birds throughout parts of Asia, Africa, and Europe. As of late January 2017, detections of H5N8 HPAIV have been reported in 33 countries including many Western European countries such as Denmark, France, Ireland, Spain, and the United Kingdom. These particular viruses appear to infect a wide spectrum of wild birds including waterfowl, shorebirds, and raptors, such as common buzzard (*Buteo buteo*), peregrine falcon (*Falco perigrinus*), and white-tailed eagle (*Halieetus albicilla*), and other species. Early genetic evaluation of some of the HPAIV isolates have determined that they contain a hemagglutinin that is closely related, but distinct from the Group A clade 2.3.4.4 H5 viruses in circulation in 2014. These viruses have been termed "Group B clade 2.3.4.4."

To complicate things further, H5N6 HPAIVs that also contain Group B clade 2.3.4.4 H5, are



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co-circulating in wild birds and domestic poultry in Asia. This strain reportedly has been involved in multiple human deaths. South Korean popular media reported that it was isolated from two dead cats that were found in close proximity to an infected poultry farm, but this could not be confirmed with official sources. It remains to be seen if the Group B clade 2.3.4.4 viruses will follow their predecessor's footsteps into North America.

The events of the last few years continue to raise questions about the involvement of wild birds in HPAIV outbreaks. It is widely accepted that wild birds harbor low pathogenic AIVs that occasionally are transmitted to domestic poultry where the viruses reassort genetically in densely housed birds to become highly pathogenic. Prior to 1996, the transmission of AIVs from domestic poultry to wild birds appeared to be rare and unidirectional with only one case of HPAIV detection in wild birds in 1961 in South Africa. However, over the past 20 years, it has become clear that wild birds play a role in disseminating HPAIVs, but there are many remaining questions related to the potential for long-term maintenance of these viruses in wild bird populations. Surveillance and research at SCWDS focus on gaining a better understanding of what drives AIV infection dynamics in wild birds. Through this work, we hope to better anticipate, detect, and respond to the next big outbreak. (Prepared by Charlie Bahnson)

## A True Wildlife Professional

Shortly before the holidays SCWDS received an email from Mr. Evin Stanford, the Private Lands Program Coastal Plains Supervisor with the North Carolina Wildlife Resources Commission (NC WRC). His email described a December 2016 incident during which Chris Turner, a wildlife biologist with NC WRC, received a telephone call from a hunter who had harvested a deer in Gates County with hair loss on its head and shoulder. From the hunter's description, it sounded like the hair loss was due to minor trauma or perhaps mange. Mr. Stanford's email follows: "*However, Chris had the head retrieved and when he examined it he recognized that this was an unusual case* (Figure 1)*. Chris recalled possibly seeing a photograph of a deer with this condition in a past issue of the SCWDS BRIEFS and contacted a colleague who accessed the electronic version of the January 2014 issue. The deer in the BRIEFS had hair loss that perfectly matched the diseased deer from Gates County and was diagnosed with rabies.*

*Chris instructed the hunter not to consume any meat from the deer, which already had been butchered. Around 9 PM that evening, Chris contacted the regional health department director who asked him to immediately bring the head to his home. The deer was submitted for rabies testing and came back positive.*

*Chris' ability to recall this condition being described in the SCWDS BRIEFS three years ago, his tenacity to follow up on the case from the initial phone call through testing of the animal, and the close professional relationship he had developed with the health director allowed him to set into motion the necessary steps to quickly have this animal tested and diagnosed.*

**Figure 1**

*The hunter and at least one other individual underwent post-exposure rabies treatment, although they wore protective gloves and took other precautions (as did NC WRC staff involved with this animal). Chris' actions quite possibly prevented what could have been a disastrous situation, and perfectly illustrate his extreme competence, his follow-through, and his commitment to a high level of public service. Excellent work Chris!!*



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*I should also note that the outcome of this situation was dependent on the 2014 SCWDS BRIEFS article with the accompanying picture. Kudos to SCWDS for highlighting these kinds of unusual disease cases in the BRIEFS, and for keeping wildlife professionals informed on disease issues: this information can prove invaluable!"*

In his email Mr. Stanford also wrote, "*I wanted to take time to share this case with you, as I feel it is a perfect example of the value of a true wildlife professional and the profession itself*." We cannot agree more, and we are including a photograph of the rabid deer from this report in hopes that it could prove helpful to someone in the future. We continue to diagnose rabies at SCWDS in several species, including another North Carolina deer since the first of the year. (Prepared by Evin Stanford and John Fischer)

## Rodenticide Poisoning in an Eagle

An adult, female bald eagle died shortly after landing in a pond in Collier County, Florida, and was submitted to SCWDS by personnel from the Florida Fish and Wildlife Conservation Commission. Gross examination revealed extensive hemorrhage within the body cavity and upper gastrointestinal tract (Figure 2). Infection with avian influenza virus or arboviruses was not detected, and the brain cholinesterase activity and liver heavy metal values were within normal limits for bald eagles. Shotgun pellets were detected on radiographs and during necropsy, but were regarded as incidental findings due to the lack of associated hemorrhage. The ultimate cause of death was determined to be extensive internal bleeding, and the anticoagulant rodenticides (ARs) brodifacoum (490 ppb), bromadiolone (85 ppb), and difethialone (trace) were detected in the liver, supporting AR toxicosis as the likely cause of the bleeding.

Anticoagulant rodenticides, commonly referred to as "rat poisons," are used to control rodent populations worldwide. Anticoagulant rodenticides interfere with the production and recycling in the liver of clotting factors that are dependent on vitamin K. Over time, the clotting factors are depleted and exposed animals are at risk of life-threatening hemorrhage. First generation anticoagulant rodenticides (FGARs), such as warfarin, were developed in the 1940's to control rodent pests and were replaced with second generation anticoagulant rodenticides (SGARs) around the 1970s, due to resistance to FGAR in some rodent populations. Second generation anticoagulant rodenticides have a longer half-life than FGARs and can bioaccumulate with repeated exposures.

Although the risks for intoxication of non-target wildlife are highest in birds and mammals, exposure to SGARs has been documented in reptiles, fish, and invertebrates. Any bird or mammal potentially is susceptible to AR intoxication, but species more likely to consume bait or rodents that have consumed bait are at higher risk. Among domestic animals, non-target intoxications are relatively common in domestic dogs that inadvertently consume AR compounds in baits or poisoned rodents.

**Figure 2**

The impact of ARs on non-target species is not completely understood and is being investigated. SCWDS has diagnosed AR intoxication in a number of bird species, including bald and golden eagles, as well as raccoons, badgers, gray foxes, and gray and fox squirrels. Accidental and intentional intoxication has been documented. In addition, we commonly find low levels of ARs in bald eagles and other raptors, although at these levels the ARs are regarded as incidental findings.



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It is important that the ante or post mortem diagnosis of AR toxicosis be based on evidence of coagulopathy, as was observed in this case, and not simply on AR detection in the liver. There is wide variation in detected tissue AR levels in the literature, and these are difficult to interpret because the dose required to kill half of an exposed group (LD 50), often is unknown and may be species-specific. Acute AR toxicosis may result in hemorrhage, severe anemia, hypoproteinemia, and delayed clotting times before death. However, AR exposure may not lead to death in all instances, and studies suggest that clinical signs, such as lethargy and incoordination, may be apparent at sublethal exposure levels. It is speculated that sublethal exposure could impact the ability to find and capture food, which could increase the likelihood of starvation, trauma, predation, and susceptibility to infectious and parasitic diseases.

The impact of AR exposure in birds of prey populations remains controversial and is not completely understood. Several studies have looked at the incidence of SGAR exposure in native raptor species over the past decade. Depending on the species, the percentage of raptors exposed to ARs ranges from 33-100% in European studies and from 49-100% in North American studies. Recent surveys indicate that there may be significant variation in levels of exposure by species, even in the same geographical area, presumably associated with differences in diet. The AR that has been detected most often is brodifacoum. This SGAR was banned from household use by the EPA in 2008, but its use continues in agricultural and commercial pest management settings in the USA. (Prepared by Heather Fenton, John Bryan, and Jennifer Leonard [UGA College of Veterinary Medicine])

## BIG News at SCWDS

We have several exciting developments to report. SCWDS acquired much needed space on the lower floor of the Wildlife Health Building when the University of Georgia's (UGA) Veterinary Teaching Hospital relocated its storage area to the hospital's new location in 2015. Renovations began last summer, and we recently moved into the new space downstairs. We now are conducting necropsies in a spacious, well-lighted necropsy laboratory complete with walk-in cooler and walk-in freezer. The new necropsy suite has access to a loading dock, locker and changing area, and a restroom with shower. These amenities represent substantial improvements in our facility and provide a comfortable, biosecure, and safe area to perform postmortem exams and other diagnostic tasks.

Also included in the space downstairs is a large laboratory where research and diagnostic testing will be conducted in support of SCWDS pathogen research and surveillance projects. Our crowded situation upstairs will be eased when several of us move into new office space downstairs.

The renovations and acquisition of equipment were funded by the University of Georgia (UGA), the UGA College of Veterinary Medicine (CVM) and the Southeastern Wildlife Health (SEWH) Development Fund, a 501 (c)(3) organization that supports wildlife health work in the Southeast through the generous contributions of SCWDS supporters.

We have good news about space upstairs, too. A storage room has been renovated into a new molecular parasitology diagnostics and research laboratory. The addition of this new space allows us to separate functions that previously were combined in our old "parasitology" laboratory, which now will be used primarily for cell culture and processing of samples from clinical cases and the field. Combined, these two rooms provide 3,000 square feet of laboratory space with 250 linear feet of bench space. The cost of renovating this space was split between SCWDS and the Warnell School of Forestry and Natural Resources.

The next development to report is the first endowed SCWDS position in our 60-year history! This position, the UGA College of Veterinary Medicine Professorship in Wildlife Health, was endowed by funds from the SEWH Development Fund and the CVM. It is linked to the SCWDS Director's position, and John Fischer has been appointed to it by the UGA Board of Regents. The endowment will provide more than $10,000 in discretionary funds annually in support of SCWDS research, teaching, and service projects


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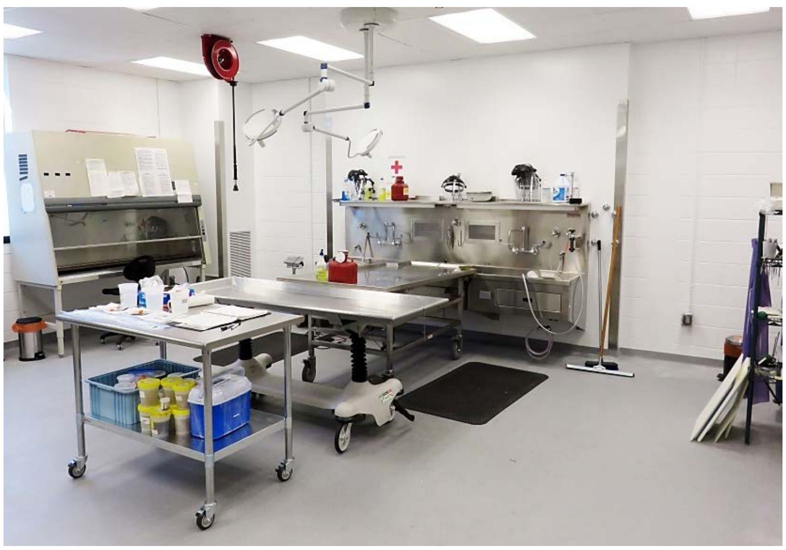
for our supporters. The endowment can be increased at any time through directed contributions, as can the SEWH Development Fund, and we encourage you to consider supporting SCWDS and wildlife health through your tax-deductible donations.

In fact, there has been a recent contribution to the SEWH Development Fund in support of a SCWDS graduate student! The Michael Dew Scholarship Fund and the American Woodcock Society provided a generous donation to partially support a graduate student who is hard-working, has an excellent academic record in the field of wildlife diseases, has financial need, and supports hunting as a conservation tool.

We deeply appreciate your continued strong support of SCWDS and are proud to report the fantastic progress that your contributions are making possible. To make a donation or acquire more information on the Southeastern Wildlife Health Development Fund, please visit http://vet.uga.edu/scwds/donate or contact John Fischer.



SCWDS necropsy suite

Necropsy table and sink

Pathogen research and surveillance lab

Molecular parasitology lab

# SCWDS BRIEFS

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Information on SCWDS and recent back issues of the *SCWDS BRIEFS* can be accessed on the internet at www.scwds.org. If you prefer to read the BRIEFS online, just send an email to Jeanenne Brewton (brewton@uga.edu) or Michael Yabsley (myabsley@uga.edu) and you will be informed each quarter when the latest issue is available.