

4-2010

SCWDS Briefs: Volume 27, Number 1 (April 2010)

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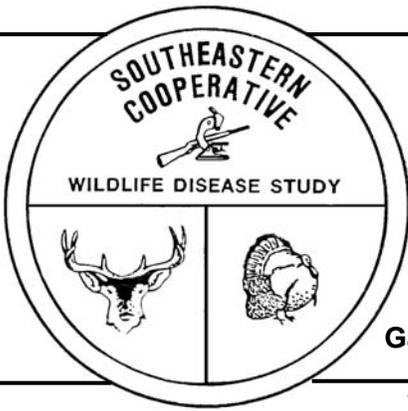
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Doster, Gary L., Editor, SCWDS Briefs and Yabsley, Michael J., "SCWDS Briefs: Volume 27, Number 1 (April 2010)" (2010).
Publications of the Southeastern Cooperative Wildlife Disease Study. 47.
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SCWDS BRIEFS

A Quarterly Newsletter from the
Southeastern Cooperative Wildlife Disease Study
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Volume 27

April 2011

Number 1

White Nose Syndrome Update

White nose syndrome (WNS), the fungal disease that has been decimating bat populations in the eastern United States, continues to rapidly expand its range. WNS has killed millions of hibernating bats since its discovery in New York State in 2006. The cumulative mortality has been as high as 99% of hibernating bats in affected caves when WNS has been documented in multiple years.

In March and April 2011, WNS was confirmed in two previously WNS-free states - Ohio and Kentucky. On March 18, 2011, bats were collected from an abandoned mine in the Wayne National Forest in Lawrence County in southern Ohio. Wildlife biologists documented that more than 1,300 bats were hibernating in the cave, including the little brown bat (*Myotis lucifugus*), the endangered Indiana bat (*M. sodalis*), the tri-colored bat (*Perimyotis subflavus*), and other less numerous species. Approximately 15% of the little brown bats had lesions consistent with WNS, and two of these bats were euthanized and submitted to SCWDS. Antemortem samples were collected from an Indiana bat by pressing clear cellophane tape on the suspected area, and the tape was examined microscopically for spores of the fungus. *Geomyces destructans*, the fungus that causes WNS, was present on the tape lift sample, and WNS was confirmed by histopathology in one of the euthanized little brown bats. The Ohio Department of Natural Resources Division of Wildlife and supporting agencies already had issued a comprehensive mine closure order on Forest Service property in 2010 and continue active disease surveillance and management strategies in an attempt to curtail the spread of WNS.

On April 1, 2011, a biologist at Murray State University collected a little brown bat from a privately-owned cave in Trigg County in southwest Kentucky, which is adjacent to Montgomery County, Tennessee, where WNS was confirmed in April 2010. About 400 little brown bats were inhabiting the cave at the time, 10 of which had noticeable lesions suggestive of WNS, including white fungal growth on the muzzles. The collected bat was submitted to SCWDS and was positive for WNS by histopathology and polymerase chain reaction (PCR) assay. Other species present in the cave included northern *Myotis* (*M. septentrionalis*), gray bats (*M. grisescens*), and tri-colored bats. The cave is regularly used as a hibernaculum by over 2,000 bats, including the endangered Indiana bat. Measures taken by the Kentucky Department of Fish and Wildlife to limit the spread of WNS beyond the affected cave included removing and euthanizing 60 highly suspect little brown bats and tri-colored bats and affixing barriers to prevent bats from roosting in areas of the cave known to harbor infected individuals. Caves within a 16-mile radius were checked, and no additional affected sites were found.

White nose syndrome has been confirmed in 16 states and three Canadian provinces. The unprecedented decline in bat populations in affected caves due to WNS could have significant effects on agriculture, because bats feed on many insects that are agricultural pests. A recent article in *Science* magazine estimated that the value of bats to the agriculture industry is at least \$3.7 billion/year and may be as high as \$53 billion/year. Based on extrapolations of average feeding amounts and the number of bats lost due to WNS, it is estimated that between 660 and 1,320 metric tons of insects are no longer being consumed each year in

Continued...

WNS-affected areas. As WNS continues to spread, this could have a major impact on crop production. Federal, state, and local agencies continue to use surveillance and response plans in an attempt to slow the spread of WNS and to identify it in new locations. (Prepared by Carolyn Hodo, senior veterinary student, University of Georgia College of Veterinary Medicine)

Respiratory Disease in Gopher Tortoises

Upper respiratory tract disease (URTD) is a highly contagious disease that has been implicated in the recent declines of the desert tortoise (*Gopherus agassizii*) and the gopher tortoise (*Gopherus polyphemus*). Both *Mycoplasma agassizii* and *M. testudineum* can cause URTD. The gopher tortoise is state-listed as endangered in South Carolina, threatened in Florida and Georgia, and federally-listed as endangered in Louisiana, Mississippi, and western Alabama. The listing of eastern populations currently is under review by the U.S. Fish and Wildlife Service. The highest densities of tortoises are found in isolated populations in Florida and southern Georgia. Throughout their range, the primary threats to gopher tortoises are disease and anthropogenic factors including habitat loss, habitat fragmentation, and translocation. Translocating gopher tortoises increases the potential of exposing naïve populations to either *M. agassizii*, *M. testudineum*, or to novel strains of these disease agents already present in the population.

Considerable research has been conducted on gopher tortoise health issues in Florida where *Mycoplasma*-related URTD is a significant health concern and where populations have declined by more than 50% over the past 100 years. In the 1990s, researchers at the University of Florida developed a serologic enzyme-linked immunosorbent assay (ELISA) to detect antibodies against *M. agassizii*. Surveys throughout Florida have shown that the prevalence of *Mycoplasma* and URTD was highly variable by site, and URTD was significantly associated with *Mycoplasma* prevalence in the population. In general, tortoises with URTD have mild to severe nasal and ocular discharge, conjunctivitis, and swelling

of the eyes and nares (Figure 1.). Although both *Mycoplasma* species can cause clinical disease in gopher and desert tortoises, disease does not always develop in naturally infected tortoises.



Figure 1. Gopher tortoise from Baker County, Georgia, with nasal exudate and swollen eyes consistent with the clinical signs of URTD.

In 2009, a joint project between SCWDS, the Jones Research and Ecological Center at Ichuaway Plantation in south Georgia, and the D.B. Warnell School of Forestry and Natural Resources at the University of Georgia was initiated to study *Mycoplasma* and URTD in Georgia populations of gopher tortoises. URTD infection status in many Georgia tortoise populations is unknown, and the limited information available is based on old and/or anecdotal observations (land managers observing sick tortoises). Historically, 182 tortoises were tested from a single site in Baker County, Georgia, in 1997, and 96% were seropositive. In contrast, only one of 100 tortoises sampled from Moody Air Force Base in South Georgia between 1995-2005 was positive for antibodies to *M. agassizii*. In 2009, we resampled the Baker County site, and 95% of 103 tortoises were positive for *Mycoplasma* antibodies and 18% exhibited clinical signs consistent with URTD.

In 2010, expanded surveillance at six other sites throughout Georgia yielded interesting results: Animals in four of the 2010 sites were positive for antibodies to *Mycoplasma*, with high prevalence rates (93-100%) being detected at the sites in Colquitt, Cook, and Mitchell counties. A relatively isolated site in Telfair County,

Georgia, had only one positive tortoise out of 35 sampled. The two negative sites (Camden and Richmond counties) had low populations of tortoises and sample sizes were relatively small. In addition to *Mycoplasma* surveillance, these tortoises are tested for several other potential pathogens, as well as internal and external parasites. An interesting finding has been the absence of infestations with *Ornithodoros turicata*, a soft tick that has been found throughout Florida and is a known vector of *Borrelia* spp., the spirochetes that cause relapsing fever in humans.

The factors that predispose a tortoise to develop clinical disease following infection with *M. agassizii* or *M. testudineum* are unknown. It is speculated that clinical illness develops following periods of stress (natural, such as flooding, or human-induced, such as habitat disturbance), introduction of novel and potentially more pathogenic strains of *Mycoplasma*, or co-infection with other pathogens. It is unclear why some populations of tortoises have obvious signs of chronic disease, such as nasal scarring, whereas other populations that also are positive for *Mycoplasma* have little evidence of chronic disease. For now, these uncertainties make it of paramount importance that care be taken when translocating tortoises, and the URTD status of the receiving and translocated populations should to be taken into consideration. (Prepared by Jessica Gonynor and Michael Yabsley)

Feral Hog Information

Feral hog populations continue to spread in the United States, and with their spread comes increased damage to forests, agriculture, native wildlife, and the environment. SCWDS began mapping the distribution of feral hogs in the United States in 1982, and in 2008 we began continuous monitoring of the distribution of feral hogs through the National Feral Swine Mapping System (NFSMS) (see SCWDS BRIEFS Vol. 24, No. 1). The NFSMS site can be accessed on the internet at www.feralswinemap.org.

The number of states reporting established populations of feral hogs grew from 17 in 1982 to 28 in 2004, and there now are 37 states with populations of feral hogs. This rapid expansion is due to the natural spread of feral hogs from

existing populations into new habitat, escapes from hog pens, and the deliberate introduction of feral hogs into new areas and new states, presumably by hog hunters. With the increases in feral hog populations and associated damage, there is a need for easily accessible and accurate information for landowners and managers wishing to control hogs and the damage they cause.

The Extension Unit in the Department of Wildlife, Fisheries, and Aquaculture at the Mississippi State University Extension Service recently released a 31-minute video entitled *A Pickup Load of Pigs: The Feral Swine Pandemic*, and the Extension Service also established a website that will help explain the feral hog problem and provide useful information. The video is available through their website, <http://wildpiginfo.msstate.edu>, and also can be viewed on *YouTube*, <http://www.youtube.com/watch?v=vTlxox-46Aw>. The video addresses the issue of feral hogs as a nuisance species of growing concern and includes excellent footage of feral hogs, feral hog damage, and interviews with landowners, scientists, and state and federal agency experts on feral hogs. It discusses the biology, behavior, and distribution of feral hogs and the damage and threats they present to native wildlife, agriculture, forestry, and public health in the United States. The video also provides landowners with instructions on legal methods for controlling feral hog populations and minimizing damage to their property. The website itself expands on this and provides additional information on feral hog biology and behavior, traps and baiting, hunting, damage to crops and forests, threats to native wildlife, damage to the environment, and public health issues. The website also includes a link to the recently released *Landowners Guide for Wild Pig Management: Practical Methods for Wild Pig Control*, a joint publication developed by the Mississippi State University Extension Service, the Alabama Extension Service at Auburn University, and the Alabama Department of Conservation and Natural Resources. (Prepared by Joseph Corn)

Frogs and *Salmonella*

Kissing a frog may have more serious consequences than fairy tales would have you

believe. Over the past two years, an outbreak of *Salmonella* linked to pet frogs has sickened people in 41 states. This is the first multistate outbreak of *Salmonella* infections associated with amphibians. Infections with the outbreak strain have been reported in 217 individuals since April 9, 2009, and are largely associated with contact with pet African dwarf frogs (*Hymenochirus poettgeri*) or their habitats. African dwarf frogs are native to Africa and are commonly sold as ornamental pets for aquariums. The frogs associated with the outbreak have been traced back to a breeder in California, where *Salmonella* has been isolated. The isolates currently are being tested to confirm that they match the outbreak strain. Infected humans ranged in age from less than one year old to 73 years old, with a median age of five years old. Seventy-one percent of the patients were less than 10 years old.

This outbreak illustrates the importance of continual public education on *Salmonella* risks. When queried during the investigation, 53% of patients were aware of the potential to contract *Salmonella* from pet reptiles, but only 31% were aware of the potential from pet amphibians. Awareness of the risks of illness associated with reptiles appears to have increased since an outbreak of *Salmonella* associated with pet turtles occurred in 2007-2008, when only 20% of infected individuals reported awareness of the link between *Salmonella* and turtles or other pet reptiles. Current education efforts regarding the risk of *Salmonella* exposure associated with reptiles need to be expanded to include aquatic frogs and other amphibians. Education should include instructions on proper handling of frogs and cleaning frog aquariums. African dwarf frogs spend most of their time at the bottom of their aquariums and are seldom handled directly, so the method of *Salmonella* transmission more likely is contact with contaminated water and other materials that are part of the frog's habitat, rather than with the frog. Aquarium water is an ideal environment for *Salmonella* growth, and the organism has been recovered from water, gravel, filtration systems, and the lid of aquariums where pet frogs were kept. Several patients reported cleaning their frog's aquarium in the kitchen sink, which poses a risk for food contamination. Preventive measures include washing hands thoroughly

with soap and water after handling anything that comes in contact with water frogs and disinfecting any surfaces that the aquarium water contacts. Pet stores and other exotic animal vendors should inform customers of the risks involved with caring for amphibians and reptiles, especially when young children and/or immunocompromised persons will be exposed to the animal. For more details and recommendations, see the website of the Centers for Disease and Prevention (CDC): <http://www.cdc.gov/salmonella/water-frogs-0411/040711/index.html>. (Prepared by Carolyn Hodo, senior veterinary student, University of Georgia College of Veterinary Medicine)

Feral Cats and Wildlife

The Wildlife Society (TWS) has long opposed the maintenance of feral cat colonies and the attendant trap, neuter, release (TNR) programs practiced by many well-intended people. TWS adopted this position on feral cats in 2001 and voted in 2006 to retain it for five additional years (see SCWDS BRIEFS Vol. 22, No. 2). TWS reinforced its position with a series of articles in the spring 2011 issue of the *Wildlife Professional* (<http://issuu.com/the-wildlife-professional/docs/feralcats>). These articles were prepared by some of the nation's top wildlife experts and afford an in-depth analysis of the issues surrounding feral cats in the United States. The articles focus on the ineffectual practice of TNR in the United States, the diseases associated with large numbers of domestic cats and their effects on wildlife, the impact of feral cat colonies on wildlife populations, and the politics and ethics surrounding domestic cats today.

The domestic cat is heralded as the most invasive exotic species in the United States, and with a population estimated at 100 to 150 million they probably are the most abundant carnivores in this country. Large numbers of these cats are considered feral, and both feral and "pet" cats roam freely outdoors year round. Large populations of feral cats have caused many individuals and groups to establish feral cat colonies and initiate TNR programs to help manage these populations. However, in many cases TNR programs failed to reduce the populations to manageable levels.

Researchers estimate that domestic cats kill more than one million birds **per day** in the United States, and double that number of small mammals. A study in Wisconsin showed that feral cats kill more than eight million birds per year in rural Wisconsin and projected that feral cats killed hundreds of millions each year in the United States. Some proponents of TNR and feral cat colonies claim that well-fed cats do not kill wildlife; however, research does not support this conclusion. In managed feral cat colonies in California, researchers observed drastic decreases in the abundance of species of small mammals and birds. Because cats are predators, they practice hunting behavior **regardless of food availability**, allowing them to have a disproportionate effect on their environment.

In Florida, feral cat colonies were established near habitats of protected animals, including the endangered Key Largo woodrat (*Neotoma floridana smalli*), and the numbers of the woodrats crashed over the last two decades. Feral cats also are responsible for more than 50% of the deaths of Florida's rare lower keys marsh rabbit (*Sylvilagus palustris hefneri*). In addition, the endangered Florida panther (*Puma concolor coryi*) is at risk of infection from domestic cat diseases, such as feline leukemia and feline infectious anemia. All this led the Florida Fish and Wildlife Conservation Commission to establish a policy in 2003 opposed to TNR programs in that state (see *SCWDS BRIEFS* Vol 19, No. 2).

Domestic cats also can be a source of disease for other domestic animals, wildlife, and humans. Due to the restrictions and regulation on dogs in the United States, rabies now is more frequently reported in cats. In some areas, domestic cats are responsible for the majority of rabies post-exposure prophylaxis treatment of humans. Supporters of TNR suggest that the practice allows for vaccination of cats in colonies, but researchers have found that not all cats are vaccinated, and that re-vaccination is not always possible. Domestic cats also are the definitive host of *Toxoplasma gondii*, an environmentally-hardy protozoan parasite that causes morbidity and mortality in intermediate hosts, including humans, and has been associated with the decline of the southern sea otter (*Enhydra lutris nereis*). Cats are the

reservoir for several species of nematodes that can infect humans and other animals. Additionally, feral cats serve as hosts for numerous ectoparasites that can harbor infectious viruses, bacteria, and parasites.

For more information on this subject, there are some excellent publications available online, including brochures published by the American Bird Conservancy, a member of the Bird Conservation Alliance: *Cats, Birds, and You* (http://www.abcbirds.org/abcprograms/policy/cats/materials/cat_brochure.pdf); and *Trap, Neuter, Release (TNR) Bad for Birds, Bad for Cats* (http://www.abcbirds.org/abcprograms/policy/cats/materials/TNR_brochure.pdf). A DVD of this publication also is available on *YouTube* at <http://www.youtube.com/abcbirds#p/u/1/-fvN7FNUPas>. (Prepared by Whitney Kistler and Barbara Shock)

The Early Worm Gets the Bird

Dr. Ernie Provost, a distinguished professor of wildlife management now retired from the University of Georgia's D.B. Warnell School of Forestry and Natural Resources, taught me two things I will never forget: Mother Nature is a bitch, and wild critters never die at home with their boots on. These tenets were certainly true in the case of a great blue heron recently submitted to the SCWDS Diagnostic Laboratory.

In November 2010, a resident of Athens, Georgia, noticed a great blue heron walking in the woods near the Middle Oconee River. At the time, the heron seemed to be unsteady but passed from view. Two days later the bird was found dead not far from the river, and it was submitted to SCWDS for a postmortem examination. It was immediately obvious that the bird was emaciated. It was very lightweight, and the breast bone (keel) was prominent, with little remaining muscle.

The cause of the bird's poor nutritional condition and its ultimate death was not difficult to discern. With the abdominal muscles reflected, a large mass of what appeared to be stiffened intestines was visible (see Figure 1.). However, these weren't intestines. It was a mass of large worms adhered to the surface of the abdominal organs by fibrous connective tissue. The nematodes

actually were encased in a tube of connective tissue and inflammatory cells elaborated by the bird's body as the worms migrated through the tissue. The severe chronic inflammation, anorexia due to pain associated with feeding, or general malaise all could have contributed to the wasting of the bird's tissues.

The nematodes were *Eustrongylides ignotus*, a well-known parasite often seen in egrets and herons. The parasite can cause disease in birds of all ages and has been associated with high mortality in fledglings. Birds can become infested with the parasites when they eat fish that contain the larvae. These larvae burrow through the wall of the proventriculus and mature to the adult stage. The adult nematodes remain in fibrous tubes that communicate with the lumen of the gastrointestinal tract where the eggs are ultimately deposited.

The larvae also cause disease in other species. For instance, garter snakes may develop severe disease if they feed on infected killifish. The larvae have even sickened humans who have been bold enough, and perhaps bored enough, to swallow live bait fish. This is a rare occurrence, and the species of fish affected by larval *Eustrongylides* sp., principally minnows, such as mosquito fish and killifish, are not common food items for people. (Prepared by Kevin Keel)



Figure 1. The abdominal viscera of a great blue heron covered by a mat of nematodes encased in tubes of fibrous connective tissue (arrows). The proventriculus is beneath the mass of nematodes, but is not visible. The liver (asterisks) is oriented on the left side of the photograph.

TB in Elephants

A recent report in the *Journal of Emerging Infectious Diseases* describes the investigation of zoonotic transmission of tuberculosis (TB) from an elephant to human workers at a non-profit elephant refuge in south-central Tennessee in July 2009. The Tennessee elephant refuge has a history of having received elephants previously positive for TB from an exotic animal farm in Illinois in both 2004 and 2008. Prior to transfer into Tennessee, all elephants were quarantined in accordance with USDA and Tennessee Wildlife Resources Agency (TWRA) regulations, in consultation with the Tennessee Department of Health (TDH).

An outbreak investigation was launched at the Tennessee elephant refuge after five employees were reported to the TDH to be reactive for TB by the tuberculin skin test (TST). These TST reactions were suggestive of exposure to *Mycobacterium* spp. During the investigation the causative bacterium, *Mycobacterium tuberculosis*, was cultured from respiratory secretions recovered from the trunk wash of a quarantined resident elephant in 2009. The trunk-wash-culture method is highly insensitive, but it is the only USDA-recognized diagnostic test for elephants for detection of active tuberculosis and is analogous to culturing sputum in human patients. When positive, the trunk wash indicates that the elephant currently is shedding the bacteria into the environment and is, therefore, in the late stage of the disease. DNA sequencing of the *M. tuberculosis* cultured from the trunk wash revealed that this isolate was genotypically identical to that cultured from TB-positive elephants from the exotic animal farm in Illinois. This farm was the site of the first reported outbreak of tuberculosis among elephants in North America in 1996. The same genotype also was isolated from an elephant in Missouri in 2008 and from a human diagnosed with active tuberculosis in 2004.

The investigation demonstrated that transmission of tuberculosis from a resident elephant to a worker had occurred. Important risk factors include prolonged close contact with infected elephants. Workers with exposure to the quarantine area displayed TST conversion, despite the use of N95 respirators, which are

approved for such work by the National Institute for Occupational Safety and Health.

However, TST conversion was not limited to those workers in direct contact with potentially infected elephants. Administrative staff, who had no contact with the elephants and were located away from the barn, also became TST-positive. The construction of the barn permitted unfiltered air to flow from the barn into the adjacent administrative building, where respirators were not worn, and led to exposure of administrative staff to tuberculosis. High-pressure water sprayers used to clean the barn may have led to aerosolization of *M. tuberculosis* excreted from the elephant, with subsequent circulation into the adjacent administrative building. Therefore, TST conversion in administrators supports evidence for a second, indirect route of transmission that previously was overlooked.

The outbreaks at the Tennessee elephant refuge, as well as the Illinois outbreak in 1996, have resulted in a revision in TB surveillance and management in captive elephants within the United States. However, despite attempts at improving the sensitivity of diagnostic tests aimed at detecting TB in elephants, further research is required to enhance our current diagnostic tools, as well as our understanding of the pathobiology of elephant tuberculosis, and therefore improve our ability to protect the health of human workers. In addition, it is imperative that training be implemented to educate workers on the risks of zoonotic transmission of tuberculosis from elephants to humans, with an emphasis on potential routes of transmission. (Prepared by Sophie Aschenbroich, senior veterinary student, University of Georgia College of Veterinary Medicine)

Accolades

We are pleased that the hard work, dedication, and superior work ethic of Drs. Joseph Corn and Michael Yabsley have been recognized by the University of Georgia, and both have received

well-deserved promotions. Joe has been advanced to Senior Public Service Associate, and Michael was elevated to Associate Professor and was awarded tenure.

We also are proud to announce that Dr. Kevin Keel has been selected for membership in Phi Zeta, the honor society of veterinary medicine. Phi Zeta was founded in 1925 by a group of senior veterinary students in the New York State Veterinary College at Cornell University to recognize and promote scholarship and research in the veterinary community. There now are 27 chapters at colleges and universities across the country. We are delighted that Kevin has been honored by being inducted into this prestigious organization.

We are equally proud of a group of our graduate students for their accomplishments at the annual Graduate Student Research Symposium that recently took place at the University of Georgia's D.B. Warnell School of Forestry and Natural Resources. Whitney Kistler, Albert Mecurio, Barbara Shock, Joe Slusher, and Ben Wilcox, all graduate students of Drs. Michael Yabsley and Sonia Hernandez, won first, second, or third place in proposed projects, MS projects underway, and PhD projects underway.

In addition to his recent activities at the UGA Forestry School Graduate Student Research Symposium, Whitney Kistler has received another honor. Whitney was one of a small number of graduate student researchers nationwide selected to participate in this year's EcoHealthNet 2011 Workshop at Johns Hopkins University. Among the many planned activities for the five-day workshop, participants give presentations on their research projects and receive feedback from peers and instructors. Whitney will be presenting his PhD project on evaluating Canada geese as sentinels for avian influenza viruses. He also will attend a special session on manuscript preparation hosted by the editorial staff of the journal *EcoHealth*. Well done, everyone, and heartiest congratulations. (Prepared by Gary Doster)

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