SCWDS BRIEFS

A Quarterly Newsletter from the
Southeastern Cooperative Wildlife Disease Study
College of Veterinary Medicine
The University of Georgia
Athens, Georgia 30602

Phone (706) 542-1741 FAX (706) 542-5865

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White Nose Syndrome, 2013

White nose syndrome (WNS), an emerging fungal disease of bats caused by *Geomyces destructans*, continues to spread throughout North America with devastating effects on multiple species of cave-dwelling bats. WNS initially was observed on bats near Albany, New York, in February 2006. Bat mortality in affected hibernacula is more than 70% and sometimes approaches 100%. The U.S. Fish and Wildlife Service estimated that 5.7 - 6.7 million bats were killed by WNS by January 2012. A more recent estimate is not available, but vast numbers of bats have died during the two winters since then.

Seven cave-dwelling bat species have been confirmed with WNS: little brown bat, tri-colored bat, northern long-eared bat, eastern small-footed bat, big brown bat, Indiana bat, and gray bat. In addition, *G. destructans* DNA has been detected on the southeastern myotis, the cave myotis, and the Virginia big-eared bat, although clinical disease has not been confirmed. Of these species, the Indiana bat, the gray bat, and the Virginia big-eared bat are listed as federally endangered. Although Indiana bats had been approaching recovery status, the overall population declined by more than 10% annually from 2006-2009. Indiana bat numbers in the Northeast Recovery Unit population plunged from 42,710 in 2005 to just 16,060 by the end of 2011. Recent models estimate that Indiana bat populations will decline to functional extirpation in most regions they inhabit by the early 2020s, as WNS spreads to areas with larger Indiana bat concentrations. The northern long-eared bat and the eastern small-footed bat have been listed as species of concern by the USFWS since the emergence of WNS. Studies are underway to evaluate the status of these species and the need for increased conservation efforts.

White nose syndrome continues to spread throughout North America and has been confirmed in 22 states and 5 provinces. SCWDS diagnosed the first infections in Georgia and South Carolina. Illinois and Prince Edward Island also had their first confirmed cases this year. Multiple positive specimens, also diagnosed at SCWDS, have been found for the first time in Mammoth Cave National Park and Cumberland Gap National Historic Park. Although WNS has been confirmed in the Southeast for several years, cases had been widely distributed without the devastating morbidity and mortality observed in the Northeast.

It had been hoped that WNS would prove to be an environmentally constrained disease unable to cause heavy losses in warmer temperatures. Unfortunately, this has not come to pass. In the Southeast, WNS followed the previously observed pattern of light infections initially, but this expanded to widespread infection within 2-3 years. The number of WNS-positive counties has expanded markedly throughout Tennessee and Kentucky. Surveillance efforts in these areas have revealed large percentages of bats exhibiting WNS signs and aberrant behavior, such as flying in daylight and roosting near cave entrances. Reported mortality has been highest in the upper elevations, and bat counts have decreased significantly in affected areas. Environmental conditions may still prove to be a factor in bats' survival, although they are unlikely to be fully protective as WNS spreads southwards.

SCWDS also confirmed the first WNS cases in Fern Cave National Wildlife Refuge in Jackson County, Alabama, this year. Although WNS was found in another hibernaculum in Jackson County last year, Fern Cave houses over one million gray bats and is the largest known hibernaculum for this species. The disease was confirmed in gray bats last year, but no deaths have been reported.

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In Fern Cave, tri-colored bats were seen with visible fungus on their muzzles, and they were observed acting aberrantly, although mortality was not reported. All of the tri-colored bats collected were histologically confirmed to have WNS. No mortality, sickness, or aberrant behavior was observed in gray bats at that time. However, genetic material from *G. destructans* was detected. At this time, it is still unknown whether gray bats are less susceptible to WNS, or if it is again a case of early infection within this species that may eventually lead to mass mortality.

Precise modes of the transmission and spread of WNS remain unknown. Viable *G. destructans* has been found to persist in caves during the summer in the absence of bats. Although this finding proves the fungus to be a more difficult pathogen to eliminate, it does demonstrate the ability to detect the fungus by non-invasive methods. Analysis of soil samples can show the presence of *G. destructans* in caves before WNS is evident in bats, allowing more time for intervention.

Artificial hibernacula are being evaluated as a safer alternative to caves. Without the complex biotic environment found in caves, artificial hibernacula can be decontaminated during the summer. This year a retired army bunker in Maine served as the winter home of 30 male little brown bats that were captured while hibernating in New York and Vermont, transported to the bunker, and monitored throughout the winter. The retro-fitted bunker appeared to offer an adequate environment for the bats during hibernation, although some capture-related mortality occurred. Attracting bats to hibernate in these areas is the next step. Creative strategies like this are needed to help bats survive this fast-moving and devastating disease. (Prepared by Lisa Last)

H7N9 AIV in China

A novel H7N9 avian influenza virus (AIV) strain (referred to as H7N9 from here on) emerged in China earlier this year, and since February has caused over 130 confirmed human infections. Although much remains unknown, an extensive amount of research and surveillance is underway to define the epidemiology of the outbreak, understand the origin and biology of the H7N9 virus, and identify public health measures to prevent or combat human infections. Below is a summary of current knowledge on H7N9 virus.

On March 31, 2013, China first reported three human H7N9 infections to the World Health Organization (WHO). All three cases were adults from Eastern China; two were in Shanghai and one was in Anhui Province, all exhibited severe respiratory signs and developed fatal pneumonia. There was no link between the three cases. From March 31 to April 29, there were 126 additional confirmed infections with 24 (21%) deaths. Cases occurred in eight eastern provinces, as well as in Beijing, Shanghai, and Taiwan (acquired while traveling in China).

With a few exceptions, confirmed infections were sporadic, individual cases, with no obvious links to other infected humans. Although the source of the virus was not definitively identified, most confirmed human infections (for which there is information) involved recent exposure to domestic birds (primarily chickens), or their environments at live bird markets. These data suggested the H7N9 was not transmitting efficiently between humans, and most cases appeared to have been acquired at live bird markets.

China shut down its live bird markets in the affected areas in early April, and this has altered the course of the outbreak dramatically: Only three human cases were reported in May, with the last one on May 22. While this drop in new human cases is promising, it should be remembered that influenza in humans is seasonal and infection rates tend to be low during the warmer summer months and increase during the colder months of fall and winter. In addition, influenza viruses have enormous potential to evolve quickly, which can lead to dramatic changes in outbreaks.

Through a process called gene reassortment, influenza viruses co-infecting the same host can exchange one or more of their eight RNA segments, which along with mutation, contributes to the enormous potential for these viruses to quickly evolve and adapt. All of the RNA segments of this H7N9 are of Eurasian lineage and avian origin. The origin and evolution of this H7N9 is complex and appears to have involved multiple intermediate hosts and reassortment events: Six of the gene segments from the H7N9 virus likely originated from an H9N2 AIV that circulates in chickens in China. The origins of the other two gene segments are unknown, but the H7 appears most similar to an AIV from a

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domestic duck, and the N9 is most similar to an AIV from a wild duck.

As of May 31, 2013, there have been 132 human infections, with 37 deaths (28%). Historically, humans have been infected with other H7 AIV on multiple occasions, but this H7N9 appears to cause more severe disease. Infections in humans start out with non-specific signs, including a high fever and a cough, and severe cases progress to pneumonia, acute respiratory distress, septic shock, and multi-organ failure.

In order for an animal-origin AIV to cause a pandemic, the virus must evolve to allow for sustained human-to-human transmission. There currently is no evidence that sustained transmission of H7N9 between humans has occurred. However, genetic mutations have been identified in this H7N9 that previously have been associated with an increased ability of AIVs to infect, replicate, and spread between mammalian hosts. Whether or not this virus will adapt to allow for sustained transmission is unknown.

This H7N9 is avian-origin, humans likely have little to no immunity to the virus, and the seasonal influenza vaccine is not protective. The decision has been made not to launch an H7N9 vaccine program in the U.S.; however, the CDC and other agencies are working to develop a vaccine in case it is needed.

Surveillance for H7N9 in domestic animals is ongoing and its reservoir has not been identified. The virus has been confirmed in chickens, domestic ducks, and pigeons; however, there have been very few positives. As of May 24, China reportedly tested 899,758 avian or environmental samples across the country, with only 53 positive for H7N9: Two were from pigeons (one domestic and one feral), and the remaining 51 were from birds in live poultry markets. Over 4,000 swine and environmental samples from pig farms tested negative.

Clinical disease has not been reported in any infected birds, making this H7N9 a low pathogenic AIV (it does not cause severe disease or death in chickens). The lack of observable disease makes detection of infected birds difficult, and greatly hinders surveillance, monitoring, and control efforts. Experimental challenge studies of various animal species with H7N9 are being conducted to identify its host range and to guide future surveillance and response efforts.

To date, there is no apparent wild bird involvement in the H7N9 outbreak, and there have been no isolations of this H7N9 from wild birds. Overall, H7 subtype AIV are not uncommon in wild birds in North America and Eurasia, and like other AIV of low pathogenicity, most isolations come from ducks, shorebirds, and gulls. The H7N9 subtype combination is not common, although H7N9 viruses of low pathogenicity have been reported previously from North American wild birds. These historic H7 viruses from wild birds are biologically and genetically distinct from the H7N9 infecting humans in China.

It is important to keep the following points in mind as this H7N9 outbreak progresses and wild bird surveillance and research data become available:

- To accurately interpret wild bird surveillance data, sampling effort details should include information on species, age, location, and time of sampling, as well as other factors (proximity to domestic animals, live bird markets, etc.).
- Because the H7 subtype is relatively understudied in natural avian reservoirs (ducks, shorebirds, gulls), it will be important to study this novel H7N9 in wild birds and compare it to other wild bird-origin H7 AIV.
- This H7N9 outbreak has grabbed the attention of researchers, as well as the human and animal health communities globally. Preparedness and response plans are being established and modified when necessary in the U.S. and elsewhere.
- The future of this outbreak is unpredictable. Human cases may continue to decline and the H7N9 outbreak may end, or the virus may persist, evolve, and potentially cause greater domestic animal and human health impacts.

Additional information may be found at: www.cidrap.umn.edu/cidrap/index.html and www.cdc.gov/flu/avianflu/h7n9-virus.htm
(Prepared by Justin Brown)

New USDA Swine Brucellosis and Pseudorabies Action Plan

The USDA-APHIS-Veterinary Services (VS) recently published "*A New Approach for Managing Swine Brucellosis and Swine Pseudorabies Virus: Veterinary Services Proposed Action Plan*." The existing APHIS-VS programs for swine brucellosis (SB) and pseudorabies (PR) were designed to respond to detection of these diseases in commercial production swine herds. In contrast, this proposed plan will allow Federal, State, Tribal, and industry groups to move from a reactive disease eradication-based system to a proactive approach that focuses on mitigating the risk of SB and PR introduction.

One of the major issues facing the U.S. swine industry is the presence of SB and PR in feral swine. Based on data collected through the National Feral Swine Mapping System (www.feralswinemap.org), established feral swine populations currently are present in 36 states. Commercial production swine herds in the U.S. were recognized as PR-free in 2004, and all states have been free of SB since 2011; however, the most recent data from USDA-APHIS-Wildlife Services documents SB and PR in feral swine in at least 18 and 26 states, respectively. Feral swine infected by either SB or PR present a widespread and growing risk of disease transmission to commercial and transitional production swine.

The swine industry in the U.S. includes three segments: commercial production swine, transitional production swine, and captive feral swine. Commercial production swine are produced in biosecure operations and have little, if any, contact with feral swine. Transitional production swine are in less secure conditions that may allow a greater degree of exposure, and captive feral swine have been captured and moved intrastate, as well as interstate. The numbers of commercial production swine moved interstate dwarf those of transitional production swine and captive feral swine moved interstate. However, as SB and PR reservoirs, feral swine present a significant risk for introduction of these diseases into commercial production swine.

The new APHIS-VS plan presents the current thinking on possible changes to the SB and PR programs, and will allow APHIS-VS, States, Tribes, and industry to better address today's disease challenges by doing the following:

- *Combining the SB and PR programs into a single streamlined program*
- *Creating a comprehensive, risk-based, flexible regulatory framework for SB and PR*
- *Enhancing SB and PR surveillance*
- *Transitioning away from the current State classification system*
- *Revising requirements for laboratories conducting official testing*
- *Modernizing the indemnity regulations for the two diseases*

The APHIS-VS invites public input on this new plan and will consider all comments received by July 22, 2013. The plan can be accessed at http://www.regulations.gov/#!documentDetail;D=APHIS-2010-0086-0001. (Prepared by Joe Corn)

Deer Corn Recall

This press release recently was issued by the Food and Drug Administration (FDA) regarding a recall of Deer Corn found to be contaminated with aflatoxin. "*For immediate release - May 15, 2013 - Rural King Distributing of Mattoon, IL is recalling 205 tons of Deer Corn, because it has the potential to be contaminated with aflatoxin. Aflatoxin is a naturally occurring mold by-product. Animals that have consumed any of the above recalled products may exhibit symptoms of illness including sluggishness, unthriftiness, or lethargy combined with a reluctance to eat, yellowish tint to the eyes, or diarrhea. Consumption of feed containing high amounts of aflatoxin can be fatal to some animals. Deer Corn was distributed to 63 retail stores in Illinois, Indiana, Missouri, Tennessee, Kentucky, Ohio, and Michigan. Deer Corn is packaged in a green, black, and brown camouflage bags weighing 50 lbs. The product UPC Code is 689139348193. No illnesses have been reported to date. The issue was called to attention stemming from testing by the Office of the Indiana State Chemist. Consumers are urged to return Deer Corn to the store where they have purchased for full reimbursement. Consumers with questions may call the company at 1-800-561-1752 between the hours of 8 am and 5 pm CST.*"

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Aflatoxin is a mycotoxin produced by fungi in the genus *Aspergillus*, including *A. flavus* and *A. parasiticus*. The toxin may be produced by fungi in grains damaged by drought or other stressors, and can continue to accumulate after harvest and storage. Mycotoxins are important causes of disease in humans, livestock and poultry, and also can affect wildlife. Birds, fish, and mammals can be affected, with birds being more susceptible than mammals to the toxic effects. Aflatoxin is immunosuppressive, hepatotoxic, and carcinogenic, and can be found in cereal grains, corn, and peanuts. Toxicosis can occur following ingestion of contaminated materials.

Action levels for aflatoxin have been established by the FDA. Grain products contaminated with more than 20 parts per billion (ppb) are banned from human consumption, while levels of 20-300 ppb are allowed in animal feeds, depending on the species, age, and products, such as milk or meat, that will be consumed by humans. Handling wildlife during aflatoxicosis mortality events is not considered a human health risk, but these animals should not be consumed.

Deer feeding and baiting are legal in several states, and piles of shelled corn can be commonplace. In 1993, SCWDS analyzed corn from bait piles and storage bins in North Carolina and South Carolina for aflatoxin. Samples of shelled corn used for wildlife feed or bait were collected from September-November. Twenty (51%) of the 39 samples contained aflatoxins (mostly aflatoxin B1): 4 samples (10%) contained from a trace to 20 ppb, 12 samples (31%) contained from 21 to 300 ppb, and 4 samples (10%) contained more than 300 ppb. The highest level found was nearly 750 ppb. Although affected deer were not observed in the vicinity of the bait piles, some of the aflatoxin levels found clearly exceeded action levels for animals to be consumed by humans.

Clinical signs of aflatoxicosis are divided into acute, subacute, and chronic syndromes. Animals with the acute syndrome may be anemic, anorexic, and depressed, and may develop respiratory difficulty, as well as neurological signs such as ataxia and convulsions. Sudden death may occur with no observed clinical signs. In the subacute syndrome, animals live longer, and liver damage may be manifested by icterus and blood clotting abnormalities with secondary bruising, and hemorrhagic enteritis. In the chronic syndrome the effects of aflatoxicosis generally are related to impaired liver function. Long-term, low level consumption of alfatoxins may lead to reduced feed efficiency, reduced weight gains, inappetence, immunosuppression, and predisposition to develop secondary infections.

In humans, the acute syndrome primarily is associated with liver necrosis with hemorrhage, edema, altered digestive function, and neurological abnormalities. Acute necrosis may be followed later by hepatic cirrhosis and/or carcinoma. Long term subclinical exposure, especially of children, may stunt growth and contribute to developmental abnormalities, and may increase the risk of liver cancer. (Prepared by Joe Corn)

SCWDS Accolades

SCWDS students and faculty have been hard at work on their wildlife health and conservation projects, and many have been recognized with well-deserved awards.

In March of 2013, the 2nd annual student chapter of the Wildlife Disease Association symposium was held at UGA. Among the 16 abstracts submitted this year for the oral presentation competition, three were selected and we are proud to say the authors are affiliated with SCWDS. Jennifer Ballard, a PhD student in Population Health/SCWDS, presented "Investigation of Wellfleet Bay Virus Epidemiology in the American Common Eider (*Somateria mollissima dresseri*)," Jesse Thomas, a MS student at SCWDS and at the Warnell School of Forestry and Natural Resources (WSFNR) presented "Surveillance for Lymphoproliferative Disease Virus (LPDV) in Hunter-killed Eastern Wild Turkeys (*Meleagris gallopavo*)," and Whitney Kistler, a PhD student at SCWDS and WSFNR, presented "Surveillance for Various Pathogens and Lead in American Black Ducks (*Anas rubripes*) from the Northeastern and Mid-Atlantic United States." Following the oral presentations, a poster session was held. A total of 18 posters were presented by students from three colleges/schools (College of Veterinary Medicine, WSFNR, and School of Ecology) at UGA. This year's symposium had approximately 40 attendees, so the interest in wildlife diseases at UGA is excitingly strong!

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Jessica (Gonynor) McGuire was the 2013 recipient of the E.L. Cheatum Award. This award is given to a single graduate student in WSFNR who exemplifies integrity, objectivity, leadership, vision and an appreciation for a broad interdisciplinary approach to the study of wildlife conservation. She has been working at SCWDS and WSFNR since 2009, during which time she has investigated disease issues of gopher tortoises. In particular, she investigated the distribution of *Mycoplasma* in Georgia gopher tortoise populations and the impacts of *Mycoplasma*-associated disease on tortoise behavior at the Joseph W. Jones Ecological Research Center in southwestern Georgia. In addition to conducting excellent research while at UGA, she was heavily involved with outreach and public education on several wildlife conservation issues, a fact that was mentioned repeatedly in her letters of support for the E.L. Cheatum Award. Jess has successfully defended her dissertation and is now a Wildlife Biologist with the Georgia Department of Natural Resources.

Barbara Shock, a PhD student who is working on diseases of the Florida panther, was this year's winner of the Beverly Frank Hirsh Graduate Women in Science Scholarship. The purpose of this fellowship, which is awarded by the UGA's Graduate School, is to recruit, support, and encourage exceptional graduate-level study and research in all fields of life and physical sciences, with emphasis in interdisciplinary and emerging fields. Barbara also was selected as the 2012 Best Student Presentation Award winner at the annual meeting of the American Association of Veterinary Parasitologists. This award is given to the graduate student who provided the best oral presentation on their research findings.

April Conway, a PhD student working on pygmy hippo conservation in Sierra Leone, was this year's Stoddard-Burleigh-Sutton awardee. This award is a UGA-wide award for outstanding contributions in Wildlife Conservation and/or Ornithology. This award recognizes research accomplishments and is given only when an exceptional applicant is identified. April has significant dedication to wildlife conservation issues in Africa, has been a Peace Corp volunteer, and currently is serving as a Peace Corp Recruiter.

One of our newest graduate students, Shannon Curry, a MS student studying the health of urbanized white ibis populations in Florida, was this year's recipient of the Charles A. and Rose Lane Leavell Scholarship. This award is given by WSFNR to a wildlife student who has shown an appreciation for all uses and values of natural resources. Her first year has been a busy one as she already has presented her preliminary data and won two "best presentation awards" at local and regional conferences.

Scarlett Sumner, one of our undergraduate researchers, was selected as a 2013 UGA Center for Undergraduate Research Opportunities Summer Scholar based on her proposal on parasites of aquatic turtles. She will be studying the effects of basking behavior on parasite infections, as well as participating in SCWDS activities this summer. We are excited to have Scarlett working at SCWDS as she previously worked with Drs. Yabsley and Hernandez on a turtle parasite project in Costa Rica.

Finally, one of faculty, Sonia Hernandez, has had a busy year with teaching and research and recently was recognized for her excellent teaching and speaking skills. At the annual awards banquet she was awarded the Alumni Faculty Award for Outstanding Teaching by the WSFNR. This award recognizes the tremendous amount and quality of teaching she has done, as well as her heavy involvement in the UGA's Teaching Academy. In addition, the Western Veterinary Conference selected her as the 2013 WVC Avian & Exotics Continuing Education of the Year recipient.

Congratulations to all of our students and faculty who are very deserving of the awards and recognitions they have received during this past year. (Prepared by Michael Yabsley)

Listeriosis in a Wild Turkey

There has been a significant increase in the number of wild turkey submissions to SCWDS in the recent years. While avian pox is still the most common diagnosis in wild turkeys examined here, we see other interesting diseases in these birds. Earlier this year we received one such case, a hunter-harvested wild turkey from Bath County, Kentucky, that was submitted by the Kentucky

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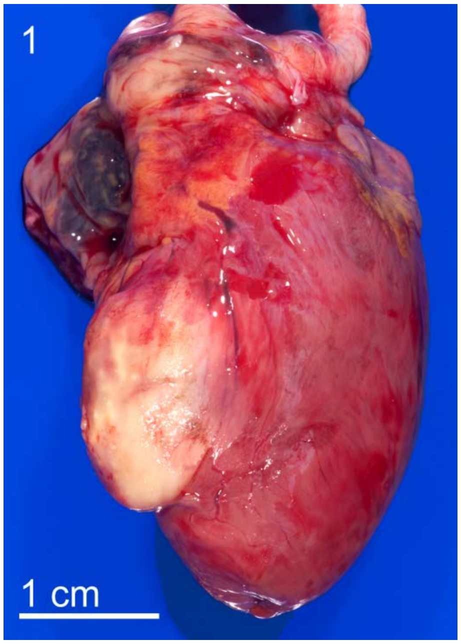
Department of Fish and Wildlife Resources to SCWDS for postmortem examination.

The turkey was in good nutritional condition with adequate subcutaneous and visceral fat. Internal examination revealed a large, yellow, firm to granular nodule extending from the right ventricular free wall of the heart (Figure 1). Bacterial culture of the lesion produced a pure, heavy growth of *Listeria monocytogenes*. Microscopically, the heart lesion consisted of granulomatous inflammation with occasional, dense aggregates of Gram-positive, rod-shaped bacteria consistent with *L. monocytogenes*.



Listeria monocytogenes, a facultative anaerobic bacterium often found in soil and poorly made silage, is present in temperate climates worldwide. It has been identified in numerous mammalian species and is most frequently associated with neurological disease in domestic ruminants. Listeriosis also is a cause of late term abortions in these animals. Infection typically is acquired through ingestion. In birds, listeriosis is diagnosed most often in domestic poultry, in which it causes septicemia with splenomegaly, hepatic and cardiac necrosis, and/or pericarditis, or encephalitis without significant gross lesions. The disease has been reported in a free-ranging eastern wild turkey in Mississippi. However, *L. monocytogenes* is rarely observed as the cause of death in wildlife, and it likely has little implication for wild turkey populations.

Listeriosis is a zoonosis, and human infections typically are due to ingesting contaminated foods such as milk, cheese, ice cream and other dairy products, as well as raw meats, fish, poultry, and sausages. *Listeria monocytogenes* is a virulent food-borne pathogen that is responsible for more than 2,000 cases of illness and 500 deaths each year in the U.S., and it is a frequent reason for food product recalls. Its ability to grow at low temperatures allows it to proliferate under refrigeration. The human health risk posed by *Listeria* in this wild turkey appears to be minimal. Of course, proper handling, thorough cooking, and appropriate hygiene greatly reduce the risk of human exposure to pathogens in any foods of domestic or wild animal origin. (Prepared by Brandon Munk)

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Southeastern Cooperative Wildlife Disease Study
College of Veterinary Medicine
The University of Georgia
Athens, Georgia 30602-4393

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