SOUTHEASTERN COOPERATIVE WILDLIFE DISEASE STUDY

SCWDS BRIEFS

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

Winter 2024 — Volume 41 — Number 4

Eds. M. Ruder and B. Kurimo-Beechuk

Banded watersnake, Corinna Hazelrig

In this issue

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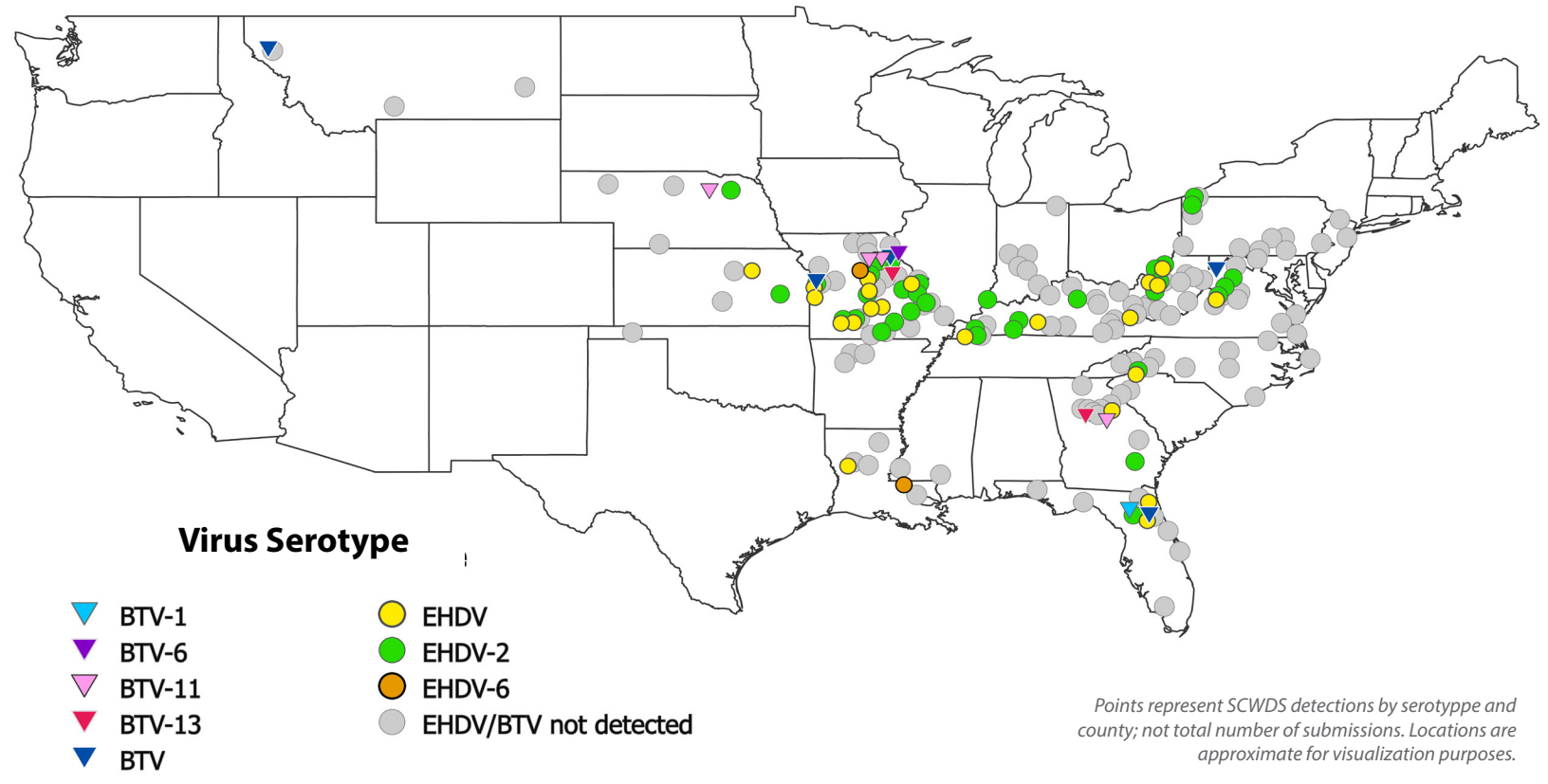
Cervid Health Updates

2023 Hemorrhagic Disease Surveillance

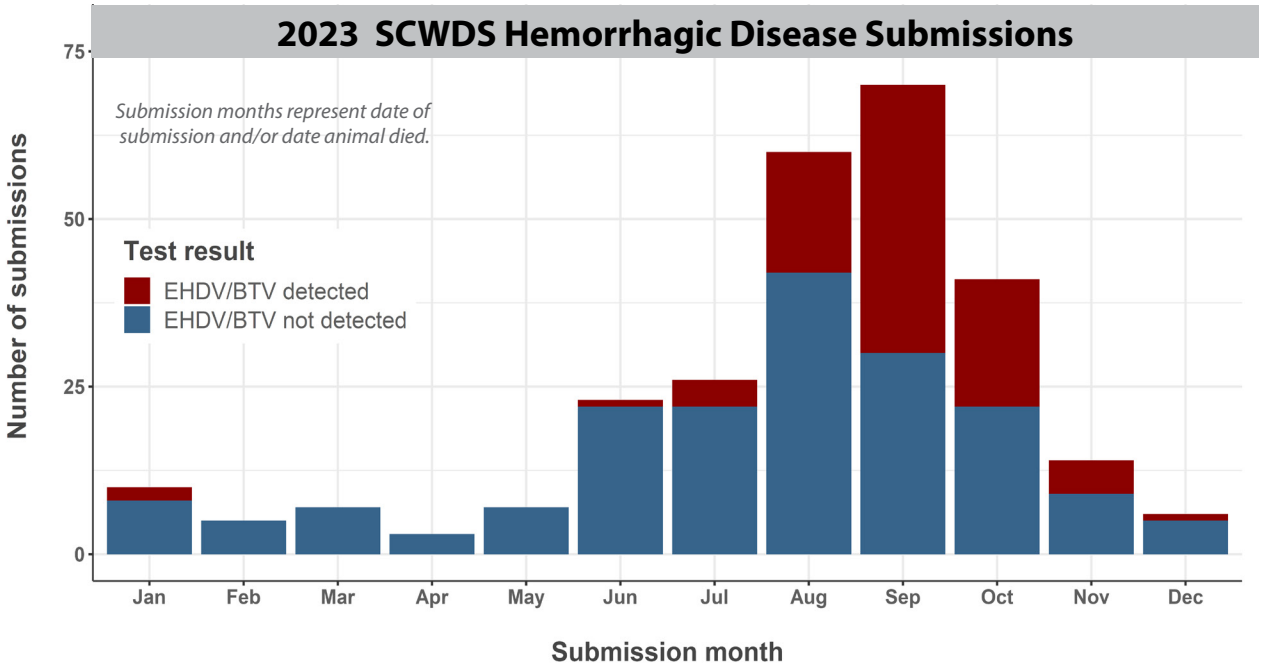
Hemorrhagic disease (HD) is one of the most important diseases of white-tailed deer throughout much of North America. During 2023, as in every year since the early 1990's, SCWDS conducted passive surveillance for EHDV (epizootic hemorrhagic disease virus) and BTV (bluetongue virus) in support of wild ruminant mortality investigations by state wildlife agencies. Annually, we receive submissions from throughout much of the U.S., and testing involves a combination of classical and molecular virologic methods. For all submissions, samples were screened for EHDV and BTV using real-time reverse transcription polymerase chain reaction (rRT-PCR) assays, and virus isolation attempted on positive samples. Virus isolates were further identified to serotype and we collaborate with virologists at USDA's National Veterinary Services Laboratories (NVSL) to further characterize BTV

2023 EHDV/BTV Disease Detections By SCWDS



Points represent SCWDS detections by serotyppe and county; not total number of submissions. Locations are approximate for visualization purposes.

detections. Here, we present results of HD diagnostics performed at SCWDS during 2023, in the map above. This passive surveillance approach is dependent upon submissions by state wildlife agencies and results of testing performed by other laboratories are not represented here. As there is no national surveillance program for EHDV or BTV in the U.S., the results of this long-term passive surveillance effort provide important information regarding annual EHDV and BTV activity in much of the U.S. From January through December, 2023, SCWDS received samples from 272 wild ruminant mortality investigations from 19 states. This included



249 white-tailed deer, 20 elk, two pronghorn, and one mule deer. The species composition and overall number of submissions were consistent with most recent years in which submissions ranged from 200 – 400 samples annually. The first detection, confirmed by both rRT-PCR and virus isolation, was EHDV-2 isolated from a white-tailed deer from southern Georgia found dead on June 30, 2023. A small number of submissions and detections followed during July before increasing in August and peaking in September, barplot above. A small number of rRT-PCR detections were made in December and January in southern areas of Georgia and Florida where transmission seasons are extended.

This profile is typical of most years, with the vast majority of submissions during August and September, as well as the highest percent positive. The geographic distribution of submissions and detections is shown in the map.

Overall, 90 individual animals tested positive for EHDV and/or BTV by rRT-PCR. EHDV was detected by rRT-PCR in samples from 78 white-tailed deer from Florida, Georgia, Indiana, Kansas, Kentucky, Louisiana, Missouri, Nebraska, North Carolina, Pennsylvania, Virginia, and West Virginia, as well as one elk from Kansas. A virus was isolated in cell culture from 52 (67%) of 78 EHDV-positive samples. Neutralization tests confirmed EHDV-2 in 50 white-tailed deer from Florida, Georgia, Indiana, Kansas, Kentucky, Missouri, Nebraska, North Carolina, Pennsylvania, Virginia and West Virginia, and EHDV-6 from two white-tailed deer in Missouri and Louisiana. BTV was detected by rRT-PCR in 16 samples from white-tailed deer in Florida, Georgia, Missouri, Montana, Nebraska and West Virginia. In collaboration with NVSL, genetic sequencing efforts identified multiple serotypes, including BTV-1 (Florida), BTV-6 (Missouri), BTV-11 (Georgia, Missouri, Nebraska), and BTV-13 (Georgia, Missouri). The number of EHDV and BTV detections and the specific serotypes involved

in outbreaks annually vary within the historical and expanding range of HD within the U.S. This variation is likely driven by interacting climatic and biologic factors that are not well defined or understood at this time. The virologic information we generate and the mortality/morbidity reports you provide not only add to a 40+ year long-term data set that can be utilized to better understand these interactions, but also serves as a baseline to detect changes in distribution, intensity, and EHDV/BTV diversity. Based on samples submitted to SCWDS during 2023, the most detections were from Missouri and the distribution of cases appear to have extended east along the Ohio River drainage on an almost latitudinal gradient. Although unclear, it is possible this distribution reflects both an association with wetlands (river and tributary bottomlands) that promote vector populations and a temperature gradient that allows for vector population expansion and viral replication within those vectors. Most detections of EHDV or BTV were within the historical geographical distribution of HD. However, EHDV-2 was detected in northern Pennsylvania, representing the forth consecutive year that EHDV has been confirmed in Pennsylvania and demonstrates the continued expansion of HD in this region. As in previous years, EHDV-2 was the predominant virus isolated and was associated with most of the cases. The virus diversity was high in Missouri – with EHDV-2, EHDV-6, BTV-6, BTV-11, and BTV-13 all isolated from white-tailed deer. The presence of multiple EHDV and BTV serotypes in Missouri is not unusual and may reflect a proximity to western ecosystems where BTV more often occurs. Of the four BTV serotypes detected this year, BTV-11 and -13 have circulated in the U.S. since at least the 1980s, whereas BTV-1 and -6 have only been detected in the last 20 years. Based on the USDA BTV serotype designations, BTV-6, -11, and -13 are considered established and BTV-1 is considered reported (see Spring 2023 SCWDS BRIEFS). Our current NVSL collaboration will enhance BTV serotype identification allowing us to better define the status of BTV in the U.S., and along with genomic data, to document the introduction and potential establishment of new viruses.

As always, we thank the many wildlife professionals who submitted tissue samples for diagnostic testing this past season. We also thank Dr. Mia Torchetti and others at NVSL for their continued collaboration with confirming and characterizing BTV isolates.

Prepared by Mark Ruder, Dave Stallknecht, Paul Oesterle, Betsy Kurimo-Beechuk, and Rebecca Poulson

White-tailed deer, Deb Carter

Funding Through Wildlife Recreation

Expenditures on fishing, hunting, and shooting equipment contribute significantly to fish and wildlife conservation in the United States: excise taxes collected on hunting, shooting, and archery equipment and supplies go directly into the **Wildlife Restoration Fund** in accordance with the **Pittman-Robertson Wildlife Restoration Act of 1937**. These funds are distributed annually to states and territories using a formula based on the state's land mass and the number of paid, licensed hunters. A similar program for the **Sport Fish Restoration and Boating Trust Fund** under the **Dingell-Johnson Sport Fish Restoration Act** provides funds collected on angling, boating equipment, and fuel to states and territories for conservation and public recreation needs in fresh, estuarine, and marine waters.


White-tailed deer, Kayla Adcock

In order to quantify the economic impact of hunter engagement, the **National Survey of Fishing, Hunting, and Wildlife-Associated Recreation** was created in 1955 and is conducted every five years to provide accurate state-level estimates of participation rates, demographics, and economic impacts of wildlife-associated outdoor activities. The 2022 survey was supported by a Multistate Conservation Grant that was funded from the Wildlife Restoration Fund and the Sport Fish Restoration and Boating Trust Fund and was jointly managed by the **U.S. Fish and Wildlife Service** (USFWS) and the **Association of Fish and Wildlife Agencies** (AFWA). Historically, the survey was conducted by the U.S. Census Bureau; however, numerous changes were made for the 2022 survey to reduce respondent burden, increase the accuracy, and create a financially sustainable model for future surveys. The USFWS and AFWA partnered with the **National Opinion and Research Center** (NORC) at the University of Chicago to conduct the 2022 survey. Among the recent changes were the collection of information regarding numbers of: people aged 6-15 years in hunting and fishing in 2021, motorized boaters not associated with fishing or hunting, target shooters using firearms, and recreational archers. It is important to note that methodology changes in the 2022 survey do not allow comparison of results with those of previous surveys.

Final results of the **2022 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation** were published in September 2023. 2022 survey results showed that among U.S. residents 16 years and older, nearly 40 million people fished, more than 14 million hunted, and over 148 million people participated in wildlife watching, which includes observing, feeding, or photographing fish and wildlife in the U.S. These figures total more than 202 million people; however, this sum is greater than the actual number of participants because many people participate in more than one of the activities. The survey found that approximately two million 6-15 year-olds hunted, 10 million fished, and an estimated 48 million people six years and older participated in recreational boating. An estimated 47 million people six years and older went target shooting with firearms; 10% of them were 6-15 years old. Those engaged in archery numbered 19 million in total with 22% of them aged 6-15 years. These numbers suggest strong participation in these activities in the future.


Wild turkey, Clay Delancey

Regarding spending, the 2022 survey results indicate

that anglers spent $99 billion on fishing, hunters spent $45 billion on big and small game hunting, and wildlife watchers spent $250 billion on their wildlife-watching activities around the home and on trips away from home. Of these expenditures, which total nearly $395 billion, $91 billion was trip-related, $179 billion was spent on equipment, and $125 billion was spent on items including licenses and land ownership or leasing. These expenditures comprise more than 1.5% of the 2022 U.S. Gross Domestic Product. They are a powerful force in the national economy and reach many of its components from the large equipment suppliers to the owners and employees of the "mom and pop" shops, restaurants, and motels in rural areas.

The **Office of Conservation Investment**, formerly known as the Wildlife and Sport Fish Restoration Program (WSFR), has provided more than $25 billion for restoration and management of our country's fish and wildlife resources since its inception. It is easy to see that fish and wildlife-associated recreation continues to be hugely popular among Americans. Unfortunately, a similar program does not exist for collection of excise taxes on equipment and supplies used by wildlife watchers (e.g., bird watching), despite several efforts over the last two decades. Such a funding program would be a boon to the conservation of non-game species, which have benefited indirectly through habitat improvements for fish and game species under the WSFR program.

It is important that we all do everything we can to maintain healthy, well-managed populations and everyone can help. Think about buying licenses even if you don't fish or hunt- the license numbers will figure into the distribution of WSFR funds to your state and benefit fish and wildlife conservation.

Prepared by John Fischer with information and excerpts from USFWS and AFWA

Gopher tortoise, Mark Ruder

Snake Fungal Disease

Ophidiomycosis is an infectious disease of snakes caused by the fungus *Ophidiomyces ophidiicola* (Oo). The term snake fungal disease was coined to describe observations of skin disease in snakes, but ophidiomycosis refers specifically to infection with Oo. Here, we summarize recent findings from the literature and provide a brief update on the status of this disease in snakes in the U.S. and worldwide.

Oo is in the order Onygenales, which includes other fungi that cause reptile skin diseases (e.g. *Nannizziopsis* spp., *Paranannizziopsis* spp., and *Emydomyces testavorans*). While many reports of skin disease in wild and captive snakes have been attributed to infection with Oo, recently, fungi in the genus *Paranannizziopsis* have been detected on snakes with similar-appearing lesions (**Lorch et al. 2023**). This suggests that multiple fungi may cause similar disease in snakes, either separately or as co-infections. While the severity of ophidiomycosis varies considerably among individuals, it is often characterized by skin lesions ranging from a few rough or wrinkled scales to larger areas of thick, brown crusting (**Baker et al. 2019**). Lesions can occur anywhere on the snake's body, including the head, tail, and ventrum. In some cases, the fungus can penetrate into deeper tissues, such as muscle, bone, lungs, liver, and kidneys. Transmission is thought to occur through direct contact between snakes or through a snake having contact with soil that contains the fungus.

Both images, Corinna Hazelrig

Top image: Black rat snake with large area of necrosis, ulceration, and crusting over the face. Bottom image: Northern watersnake with focus of thickened and displaced scales with crusts.

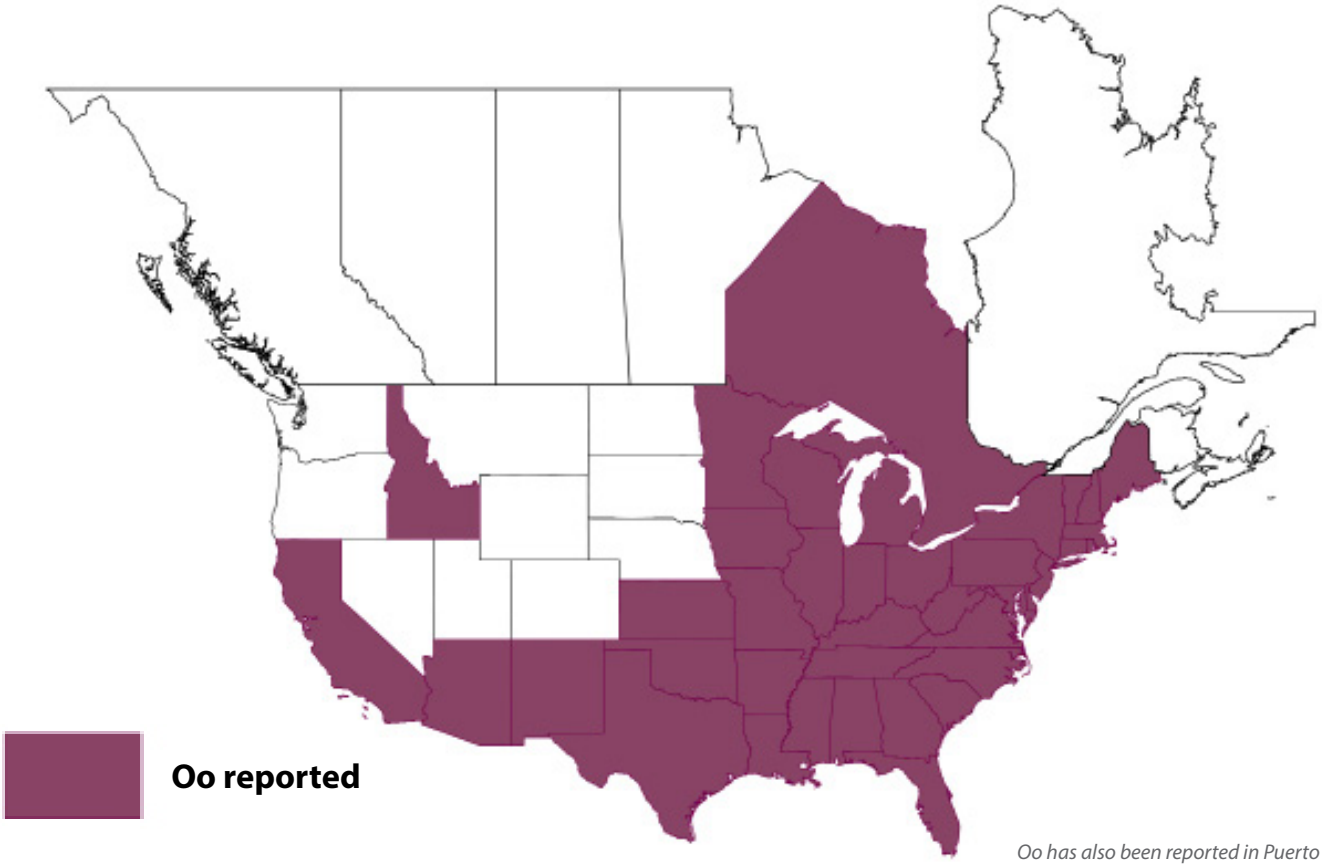
While the origins of this fungus are unknown, Oo has been isolated from museum specimens from as far back as 1945 in the United States (**Lorch et al. 2021**) and 1959 in Europe (**Origgi et al. 2022**). To-date, ophidiomycosis has been reported in 62 species of snakes from North America, Europe, Asia, and Australia (**Di Nicola et al. 2022**). This includes wild and/or captive snakes from nine different snake families and with a variety of life history characteristics, suggesting that all snakes are likely susceptible to Oo infection and disease. In North America, ophidiomycosis has been reported in free-ranging snakes from Ontario, Canada, as well as 26 states and 2 territories (Puerto Rico and the US Virgin Islands) in the United States; see map on next page (**Haynes and Allender 2021**). A recent genetic analysis indicated that there are multiple clades of the fungus and multiple introductions of the fungus into North America have occurred (**Ladner et al. 2022**). There has been a recent increase in ophidiomycosis surveillance in Europe, with the disease reported for the first time in Italy (**Marini et al. 2023**), and the Slovak Republic (**Přibyl et al. 2023**). The disease has previously been reported from Great Britain, France, Germany, Switzerland, the Czech Republic, Russia, China, Japan, Taiwan, and Australia.

While ophidiomycosis appears to be widespread in many snake populations, including species of

conservation concern, the disease does not appear thus far to have the devastating consequences of other fungal diseases in wildlife, such as white-nose syndrome or chytridiomycosis. There has been little research into management strategies at the population level, but treatment with antifungal drugs has been attempted in individuals. A promising approach is nebulization with the drug terbinafine, which has been successful in some cases, but treatment requires daily nebulization for multiple months (**Haynes et al. 2024**). Ophidiomycosis is just one of the many threats to snake health in the United States. Other pathogens impacting snakes in the Southeast include serpentoviruses and the recently invasive pentastome parasite, *Raillietiella orientalis*, in Florida. In addition, wild snakes have been documented with ranaviruses and may be impacted by pathogens known to infect captive snakes and other wild reptiles, including *Cryptosporidium serpentis*, *Chlamydia* spp., *Mycoplasmopsis* (*Mycoplasma*) spp., and *Salmonella* spp. An ongoing, collaborative research project led by SCWDS graduate student, Corinna Hazelrig, with support from multiple SCWDS faculty, is exploring the distribution and prevalence of selected pathogens in wild snakes in the Southeast to investigate their potential impacts on snake health.

Prepared by Ellen Haynes

Oo Distribution In The Continetal U.S. And Ontario, Canada



Oo has also been reported in Puerto Rico and U.S. Virgin Islands, but is not depicted in this map.

Diagnostic Case Highlight

Disseminated larval trematodiasis caused by *Clinostomum attenuatum* in a green tree frog (*Hyla cinerea*)

Clinostomum *spp. are common trematode (also known as flukes) parasites of piscivorous birds.* Clinostomum *spp. have indirect life cycles that involve three hosts including snail first intermediate hosts, amphibian and fish second intermediate hosts and avian definitive hosts. Water birds, such as herons and egrets, become infected when they ingest an infected amphibian or fish. Adult* Clinostomum *spp. flukes are often found in the oral cavity and esophagus of their water bird hosts.*

On November 7, 2015, an adult female green tree frog (*Hyla cinerea*) with raised skin nodules covering the entire body was found near a water treatment facility in Port Wentworth, Georgia, figure A. Initially, fire ant bites were suspected as a potential cause of the nodules, and the animal was brought into captivity for monitoring. Despite monitoring efforts, the frog's condition deteriorated and the frog died. The carcass was submitted to the SCWDS Research and Diagnostic Service for necropsy and diagnostic testing.

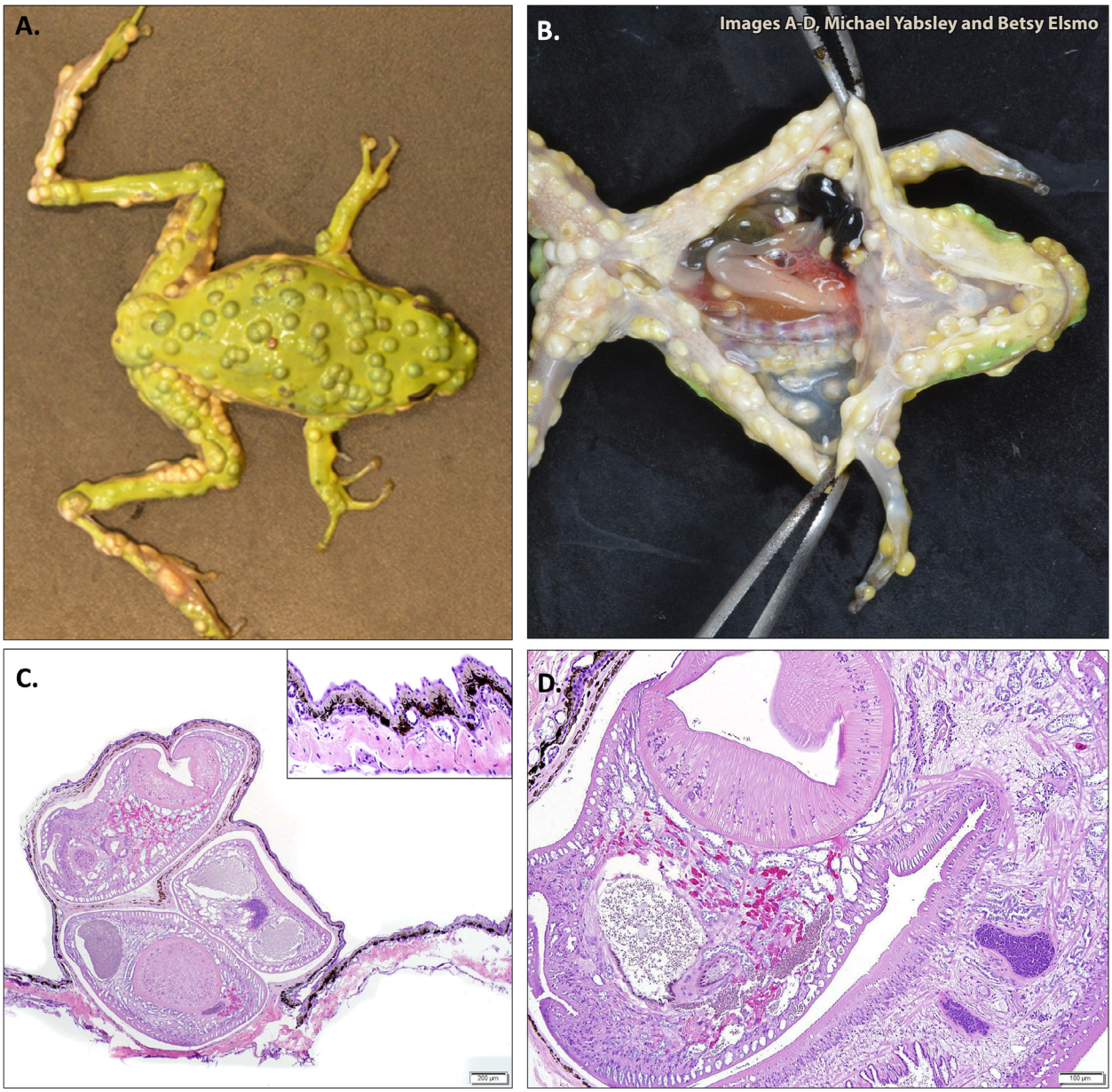
Upon physical examination, the frog was severely emaciated, dehydrated, and lacked fat stores. Grossly, the skin contained > 250 widely disseminated, raised, tan-green nodules which were uniform in shape, consistency, and size. Occasionally, certain nodules exhibited a centrally depressed region. The nodules also were scattered throughout the coelomic cavity, subcutaneous tissues of the head and within the parenchyma of the kidneys, ovaries, liver, and lungs, figure B. Most cysts contained a single larval fluke, but occasionally two or three flukes were bound by a thin, fibrous capsule.


Green tree frog, Betsy Kurimo-Beechuk

Microscopically, the nodules expanded the deepest layer of the skin and consisted of cyst-like structures surrounded by a thin layer of fibrous connective tissue infiltrated by small numbers of lymphocytes and melanomacrophages, figure C. Based on characteristic morphological features in figure D, the trematodes were identified as *Clinostomum attenuatum*. Additional PCR testing revealed no evidence of infection from *Batrachochytrium dendrobatidis*, *B. salamandrivorans*, or ranavirus. Given these findings, the final diagnosis was emaciation due to severe systemic *Clinostomum* infection.

Prior to this case, there was only a single report of *C. attenuatum* in a green tree frog from Florida (**Creel et al. 2000**). Previous reports of *Clinostomum*

Severe Trematodiasis In A Green Tree Frog

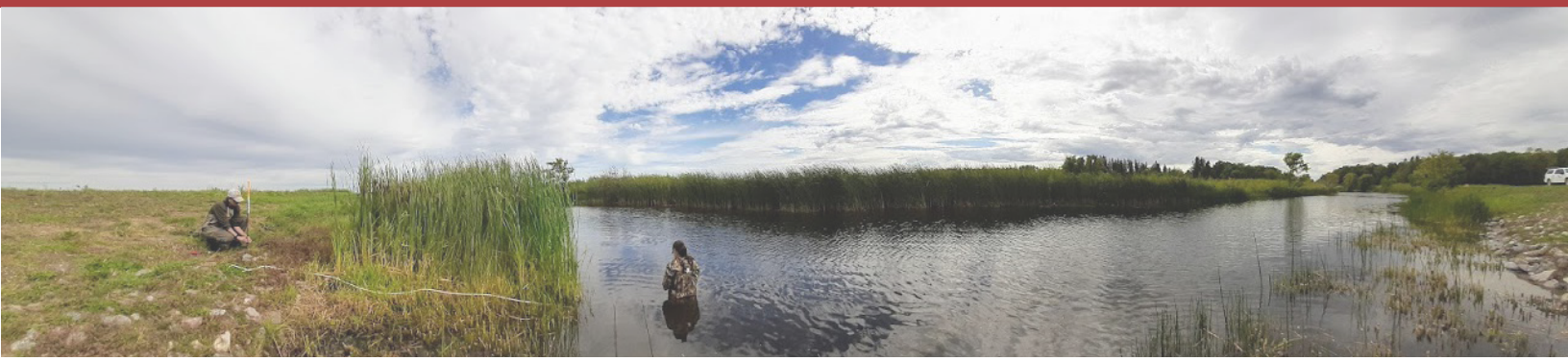


A. Extensive skin nodules at the time of presentation B. Intracoelomic nodules on visceral organs and other tissues C. Lymphocytes and melanomacrophages within nodules D) Morphologic characteristics of nematodes present within nodules.

spp. in frogs have included cysts scattered in the mesentery and body cavity, but not in the skeletal muscle and parasite burdens were generally very low (**Cort 1913**). This diagnostic case is unusual in that the parasite burden was extremely high and was believed to have contributed to the impairment of normal organ function and likely respiration, osmoregulation, and thermoregulation. It is unclear why this animal developed a heavy parasite burden, but the frog was found near a water treatment facility and poor habitat quality may have played a role. Additional studies are needed to determine risk factors for *Clinostomum* spp. infection of amphibians and their potential pathogenicity, especially in altered water bodies that may support populations of large numbers of snail intermediate hosts. We thank GA DNR for submitting this interesting case.

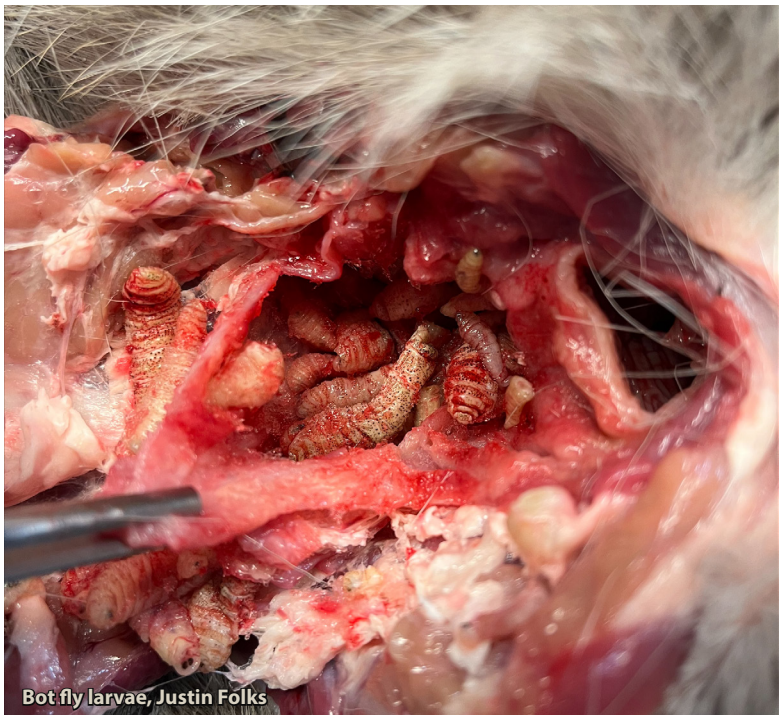
Prepared by Michael Yabsley and Betsy Kurimo-Beechuk

Notes From The Field



Recently, Justin Folks, the Deer Project Leader with the Virginia Department of Wildlife Resources (VDWR), shared these photos below of bot fly larvae collected from a hunter-harvested 8-year-old, female, white-tailed deer from Albemarle County, Virginia. While collecting samples for chronic wasting disease (CWD) testing, VDWR CWD technician Ali Keister noted a mass while collecting the lymph nodes. When she cut into the mass, she found many bot fly larvae. Between both retropharyngeal pouches she found 128 larvae!

At SCWDS, encountering bot fly larvae in the retropharyngeal pouches, nasal, and sinus cavities of deer is a frequent occurrence, but this particular number was impressive! So, we ask you – what is the most number of bot fly larvae that you have found in a wild cervid?



Bot fly larvae, Justin Folks

Bot fly larvae, Justin Folks

Click here or scan the QR code below to enter basic information about your case. We will follow-up in a future issue to let everyone know what we learn!

Prepared by Michael Yabsley and Justin Folks, VDWR

Changing Faces At SCWDS

The SCWDS family tree, with branches all over the world, continues to change and grow. Over the last year, we have had several new staff and students join the SCWDS team, as well as several departures.

Jillian Broadhurst joined SCWDS as an MS student working on the black bear mange project under the mentorship of Michael Yabsley. She obtained her BS in biomedical sciences with a focus in veterinary science and minor in wildlife and conservation biology from the University of New Hampshire. Jillian previously worked as a veterinary technician and as the conservation technician for Nebraska Game and Parks Commission within the Big Game and Disease Research Program.

Doreen Chaussadas is a PhD student working under the mentorship of Sonia Hernandez at SCWDS and Jeff Hepinstall-Cymerman at Warnell. Doreen received her BS in biology of organisms and ecosystems from the Université de Paris-Saclay, and her MS in ethology and ecophysiology Université de Strasbourg and University of Cape Town. She previously worked as a behavioral ecologist and field assistant.

Adam Edge is a new post-doctoral associate studying wild turkey pathogens and their potential population-level effects. Adam received his BSc in biology from Western Kentucky University and a PhD in forest resources with a wildlife management and ecology focus from the University of Georgia. Adam has worked in South Africa, Alaska, and north Georgia across different projects, and brings a wealth of wildlife management knowledge to his role at SCWDS.

Taylor Fisher is PhD student working on vector and pathogen ecology of wild pigs in the Southeast under the mentorship of Chris Cleveland at SCWDS and Daniel Peach at UGA's Savannah River Ecology Laboratory. She obtained her BS in animal and poultry sciences and minor in biological sciences from Virginia Tech and her MVB, a DVM equivalent, from the University College Dublin School of Veterinary Medice. Taylor has worked in shelter medicine and various private practices with captive exotic, domestic, and small ruminant species.

Mattie Green is a research technician at SCWDS working on a bat disease research project that is a collaboration between UGA, Pennsylvania State University, and the University of Florida. She received her BS in biology and AB in English literature from the University of Georgia. Prior to her position at SCWDS, Mattie worked as an animal care technician for UGA's University Research Animal Resources.

Morgan Grey joins SCWDS as a research professional and is working with Becky Poulson and others at SCWDS on numerous avian influenza virus surveillance and research projects. Morgan received her BS in wildlife biology from Purdue University. Before joining SCWDS, Morgan worked in the Indiana Animal Disease Diagnostic Laboratory performing serology and virology diagnostic testing.

Taylor Pearson is a PhD student working on ticks and tick-borne pathogens in coastal Georgia under the mentorship of Michael Yabsley and Chris Cleveland. Taylor received her BSES in entomology and BSAB in applied biotechnology from the University of Georgia. Taylor has experience working on the evolutionary genetics of adelgid bacterial symbionts and studying the diversity of *Rickettsia* spp. in ticks.

Jacob Shurba is the laboratory manager and research professional working on multiple avian influenza

Changing Faces At SCWDS

research projects in Becky Poulson's laboratory. Jacob received his BSc in wildlife ecology from the University of Wisconsin-Stevens Point and his MSc in wildlife biology focusing on waterfowl disease ecology from Clemson University. Jacob previously worked as a diagnostician in a fisheries disease laboratory and as a field biologist for a wildlife non-profit in South Carolina.

Robert Stilz joins the SCWDS team as the anatomic pathology resident. Robert obtained a BS in animal science from Berry College, and an MPH and DVM from the University of Tennessee. Robert has worked on various wildlife research projects involving coyote ecology, deer reproduction, and *Batrachochytrium salamandrivorans*.

Matt Tatz is a PhD student working on a project investigating avian influenza virus in waterfowl under the mentorship of Sonia Hernandez and Becky Poulson. Matt's project is focusing on avian influenza virus in waterfowl. Matt obtained his BS in environmental science with a minor in ecology and his MS in forestry and natural resources from UGA. Matt has previouly assisted with integrative research projects across various disciplines such as ecotoxicology, disease ecology, and urban ecology and anthropology through UGA's Center for Integrative Conservation Research.

Sarah Coker completed her post-doctoral position on the Guinea worm project working with Michael Yabsley and Chris Cleveland, and now resides in Sweden.

Daniela Guerrero completed her MNR from Warnell and has accepted a position at Warnell as an urban wildlife technician working on an urban coyote ecology project.

Jennifer Smith retired from the herd health technician position after nearly 30 years of service. During her time at SCWDS, Jennifer worked as laboratory technician and was integral to our white-tailed deer herd health evaluations - she performed many hundreds (if not thousands) of abomasal parasite counts. Jennifer also assisted with many other research projects during her long career at SCWDS. We wish Jennifer the best in her retirement.

Alec Thompson completed his PhD determining the distribution, wildlife host utilization, and population orgin of the exotic tick *Haemaphysalis longicornis* in the U.S. Alec currently works as a biological scientist with USDA-APHIS at the Foreign Animal Disease Diagnostic Laboratory in Manhattan, Kansas.

As a research unit at a land grant university, training the next generation of wildlife and animal health professionals is an important part of what SCWDS does. We are proud of our former employees and students who are now contributing to the broader wildlife conservation, agricultural, and public health communities. We look forward to watching their continued growth and expect great things.

Prepared by Betsy Kurimo-Beechuk and Mark Ruder

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Parting views from the Southeast

Black rat snake and northern cardinal nestling, B. Kurimo-Beechuk