Tracking a Deer Killer

HOW HEMORRHAGIC DISEASE IS CHANGING

By Divya Abhat

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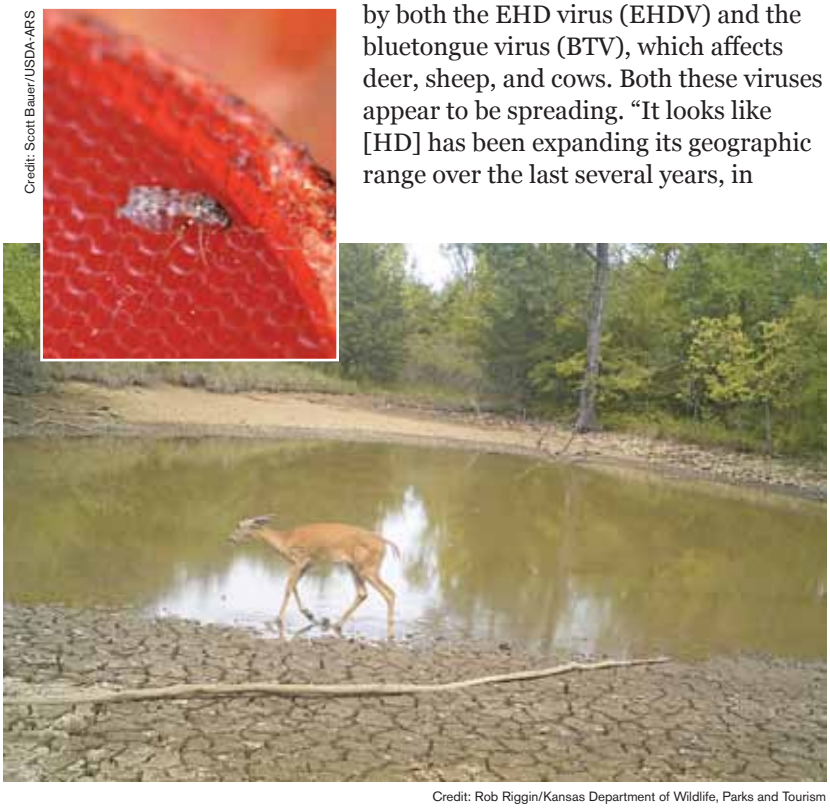
Last year, Michigan was faced with one of the worst outbreaks of epizootic hemorrhagic disease (EHD) ever to occur in the state. In all, close to 15,000 deer were reported to have died of EHD—an acute and infectious viral disease that impacts wild ruminants, primarily white-tailed deer, but also mule deer, elk, bighorn sheep, and pronghorn. "We had 30 counties involved," says Thomas Cooley, wildlife biologist and pathologist with the Michigan Department of Natural Resources. "In some cases, they were counties that had never had EHD outbreaks before." The last large outbreak that struck the state's deer occurred in 2010 and wiped out 1,000 animals.

Michigan is not alone in facing a growing problem associated with hemorrhagic disease (HD) caused by both the EHD virus (EHDV) and the bluetongue virus (BTV), which affects deer, sheep, and cows. Both these viruses appear to be spreading. "It looks like [HD] has been expanding its geographic range over the last several years, in the northward direction," says John Fischer, unit director of the University of Georgia's Southeastern Cooperative Wildlife Disease Study (SCWDS)—an organization founded in 1957 to provide state and federal agencies with expertise on wildlife diseases.



Credit: Scott Bauer/USDA-ARS

Credit: Rob Riggin/Kansas Department of Wildlife, Parks and Tourism

A deer stops by a watering hole in Crawford County, Kansas, to cool off during a recent drought. Unfortunately, watering holes such as this are also ideal spots for tiny biting midges (inset) to spread hemorrhagic disease viruses to deer and other ruminants.

What's more, researchers are seeing an increasing number of EHDV and BTV serotypes causing HD. Before 2004, only two EHDV (1 and 2) and five BTV (2, 10, 11, 13, and 17) serotypes were known to be present in North America. But in 2006, researchers detected a new strain in deer, EHDV-6 (SCWDS, Allison et al. 2010), and in 2012, "there were a large number of [HD] cases that were caused by EHDV-6 across a broad geographic range," Fischer says.

Now, researchers are trying to better understand the apparent spread of hemorrhagic disease, which can impact livestock operations and deer populations, consequently hurting livelihoods and hunting participation. Though HD has been around for years, "there are still a lot of unanswered questions," Cooley says.

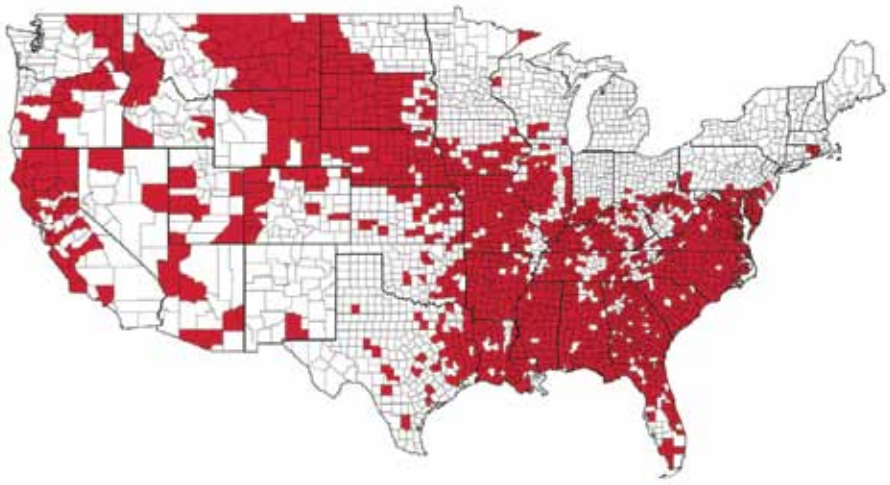
Early Origins and Spread

Because it's nearly impossible to determine whether clinical disease is caused by EHDV or BTV, researchers use the general term "hemorrhagic disease" when they're unsure of the causative virus. The EHD virus was first isolated in 1955 during an outbreak in New Jersey, where roughly 500 to 700 deer died of infection (Nettles and Stallknecht 1992, Maryland Department of Natural Resources). "The disease was very likely occurring earlier than that in North America, but that's known as the year an HD virus was first detected," Fischer says. "And it's suspected that both EHD and BT viruses were probably at work." That same year, in Michigan, roughly 100 deer were diagnosed as dying from EHD, however, the causative virus was never isolated. In 1966, scientists made their first diagnosis of the BT virus when it struck white-tailed deer and desert bighorn sheep in Texas (Robinson et al. 1967, Stair et al. 1968, Marburger 1983). Since then, wildlife professionals and animal health professionals have continued to report

EHD and BT outbreaks in deer and cattle populations.

Although typically seen almost annually in the southern U.S., in recent years, severe HD outbreaks appear to be occurring at an increased frequency in the Midwest. For example, EHD was rarely seen in Michigan between 1955 and 2006. Since 2008, however, EHDV outbreaks have occurred every single year. Further, states that haven't routinely experienced HD outbreaks, such as eastern Pennsylvania, southeastern New York and northern New Jersey, are also starting to report HD occurrences more frequently.

Hemorrhagic Disease in Deer during 1980-2003



Credit: Southeastern Cooperative Wildlife Disease Study

Red blocks show counties across the United States that reported clinical hemorrhagic disease in wild deer between 1980 and 2003. In recent years, intense HD outbreaks appear to be occurring more frequently. In 2007, for example, officials reported HD outbreaks in 31 states and 812 counties, with more than 65,000 deer mortalities recorded across the U.S. Last year, states experienced outbreaks of equal or greater intensity.

Although researchers have some theories about the apparently increasing frequency of HD, it's difficult to determine precisely what's at play. One of the suspicions involves climate change and the impacts of warming temperatures in particular. "Generally it looks like the outbreaks occur during the hot, dry summers," Fischer says, "but that's very difficult to prove scientifically." New viruses on the landscape—such as EHDV-6—might also be responsible for increased numbers of outbreaks. But factors such as higher deer populations have little to do with the spread since HD isn't a density-dependent disease.

From Vector to Death

Both EHDV and BTV are transmitted by biting flies or midges in the genus *Culicoides*. Typically, these flies are most abundant in the late summer and fall—which coincides with seasonal HD outbreaks that tend to occur from late July through November. Freezing weather kills the midges, resulting in an end to HD outbreaks. Mild winters, however, allow the larvae to survive, which is what seems to have happened in Michigan last year. "You had the perfect storm for EHD in Michigan, where you had a warmer than normal winter with not a lot of snow," Cooley says. "Then we had a hot, dry summer that was just perfect for the midges to be active, replicate the virus, and increase their density."

Researchers have found that clinical signs of infection in white-tailed deer tend to develop about a week after exposure to an HD virus. However, depending on the potency of the virus and the immunity to infection that deer may carry, some deer may show mild or no signs of infection. The virus invades the cells that line the blood vessels. Once the vessels have been disrupted, the integrity of the blood vessel wall is compromised, which results in non-cellular fluids, or serum, leaking out through the vessel walls followed by blood cells, if the animal lives long enough. "That's when you see the hemorrhage," Fischer says.

Animals infected with EHDV or BTV (or both) tend to lose their appetite and may develop a fever and severe lethargy, a swollen head, neck, tongue, or eyelids, and hemorrhages in multiple tissues. Thrombi, or blood clots, may form in damaged blood vessels cutting off the blood supply and resulting in the death of richly vascularized tissues, especially in the gastrointestinal tract. Roughly eight to 36 hours after showing signs of infection, acutely affected deer will die (Michigan Department of Natural Resources).

Not all deer populations across the United States are impacted equally. Researchers have found that, in the northeastern U.S. and the Midwest, the frequency of infection and the number of HD outbreaks tends to decrease farther north. Outbreaks that do occur in those areas, however, are typically more severe and result in a higher number of mortalities (Southeastern Cooperative Wildlife Disease Study). This regional pattern of disease might be the result of acquired immunity from a previous infection, maternal protective immunity, or an in-

Credit: Mark Ruder/USDA-ARS

nate resistance that some southern deer populations may have developed to HD.

Rates of mortality during an HD outbreak rarely exceed 25 percent, and at this level, deer populations can usually recover relatively quickly. Although HD outbreaks haven't yet impacted deer populations on a state or national scale, they can affect local populations. Last year, for example, North Carolina experienced an HD outbreak that impacted local populations of deer in a number of counties. In one particular district, officials reported a harvest of 375 deer, reflecting a 22 percent decline in the district's three-year deer harvest average (*Before It's News* 2012). Though local populations will likely rebound over time, says Mark Ruder, research veterinary medical officer with the USDA-Agricultural Research Service, HD is still a cause for concern: "It's a little bit dangerous of us to just completely dismiss the disease as not significant," Ruder says. "We're in a changing environment and we don't know if … there could be other disease threats that move in and tip the scale."

Credit: Bob Funke/Kansas Department of Wildlife, Parks and Tourism

A buck with HD (above) struggles to breathe—evident from its open mouth and protruding tongue. Affected deer are often approachable and unafraid of humans. Other clinical signs include red and swollen skin around the animal's eyes (inset). Because HD viruses don't spread to humans, it's typically safe for homeowners, like the Michigan homeowner below, to clear out HD-infected carcasses, but it's best to report sick or dead animals to state wildlife agencies.

Credit: David Kenyon/Michigan Department of Natural Resources

Managing Hemorrhagic Disease

There isn't much that agency officials can do once there's an HD outbreak except wait for the vector-killing frosts. "It's a very difficult disease to manage," Fischer says. "The first factor is that you have free-ranging wildlife populations at risk, and managing disease in free-ranging animals is very difficult. When you have an insect vector involved, it just compounds the difficulty." Still, state agencies are doing what they can to manage deer populations in the face of outbreaks, while wildlife health professionals continue to diagnose HD and conduct research to better understand it. Among the ongoing measures to address HD:

Agency Efforts. In states where deer populations are impacted due to an HD outbreak, some state agencies have begun to curtail deer hunting in order to minimize further deer mortality. Last year, in response to statewide deer die-offs, the South Dakota Game, Fish, and Parks Department gave refunds to deer hunters who had purchased licenses and also removed unsold licenses from several impacted hunting units (*South Dakota State News 2012*). Similarly, North Dakota suspended license sales in three deer management units. Further, Cooley has found that many hunters who are aware of an HD outbreak in a particular area make sure not to kill the area's does for fear of further reducing the deer population. "If you want to change something because of the effects of the disease, reducing antlerless permits or eliminating them in some instances … could minimize the impact in an area," Cooley says.

National Surveys. Every year, SCWDS sends out a questionnaire to wildlife agencies across the country asking them to report the occurrence of

HD in free-ranging wildlife in their states during the previous year. "We're looking for mortality events and other occurrences in which HD is confirmed or suspected," Fischer says. Researchers—who have been compiling such data for several decades—use the information to observe changes over time and track any apparent spread of HD across the U.S.

Research. In addition to studying HD pathology and epidemiology to get a better grasp of the disease, researchers at SCWDS have also examined susceptibility to the disease between different deer populations. For example, researchers studied populations of northern and southern deer and found that in areas in the South such as Florida and Texas, deer are exposed to the virus on an annual basis and therefore appear to have developed acquired and innate immunity to severe disease (Gaydos et al. 2002). That has not been true in the North, however, where the disease occurs less often. To test the greater susceptibility of northern deer, researchers inoculated fawns from Pennsylvania and Texas with the same amount of EHDV and found that the fawns from Pennsylvania got very sick and died, while those from Texas, as Fischer puts it, "laughed it off."

Research will continue as wildlifers strive to understand the mysteries of HD, such as how it's being moved, why it's showing up in new areas, and why it's more prevalent today. As outbreaks continue, managers will have to take measures to protect wildlife populations and explore possible preventative measures, such as constructing deer watering holes of healthy, vegetated wetlands to help reduce midge reproduction (QDMA). Wildlife professionals will also have to continue to monitor the disease closely to determine whether, as Ruder notes, epidemiological patterns are changing and if they'll continue to change over time while moving in a northward direction. With a significant viral disease on the move, wildlife professionals will need vigilance—and a mix of science and sound management. ■

This article has been reviewed by subject-matter experts.

To see additional photos of deer infected with EHDV and BTV, go to news.wildlife.org/twp. For resources on hemorrhagic disease including ongoing research, go to the Southeastern Cooperative Wildlife Disease Study.