



Pest e-alerts



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Vesicular Stomatitis Virus and the Vectors Involved in Transmission

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Vesicular Stomatitis Virus (VSV) has been confirmed in a horse in Tillman County, Oklahoma. This is a viral disease that is an economically important disease of cattle and horses but can infect all cloven hoofed animals. The typical signs are lesions around the mouth, tongue, ears,



Figure 1: A) Lesions caused by VSV in a cow - Credit: Dr. Brian Bohl; B) Oral lesions caused by VSV in a horse - Credit: Dr. Jason Lambard; C) VSV lesions in a horse's ear - Credit: Dr. Richanne Lomkin

gums, teats, and around the coronary bands (Figure 1). VSV within the United States has commonly occurred in the southwestern states of New Mexico, Arizona, Utah, Colorado, and Texas (McCluskey and Mumford, 2000). This disease is closely monitored because it is clinically indistinguishable from foot and mouth disease. It is also zoonotic meaning it can transfer from infected animals to people working those animals.

There are two serotypes commonly associated with disease in animals. VSV-serotype Indiana and VSV-serotype New Jersey have both been confirmed in the U.S. The serotype from the positive horse in Tillman Co. is the Indiana type. VSV is considered an RNA virus that is enveloped which can easily be inactivated with disinfectants (McCluskey and Mumford, 2000). This virus can survive in soil at temperatures between 40 °F and 44 °F and become inactive in temperatures above 130 °F.

While VSV is reported in horses and cattle, horses are considered more susceptible to infection with one outbreak having an infection rate of horses as high as 45% from premises sampled and only 5% in cattle on those same premises (Stanllknecht et al. 1985). During outbreaks VSV can spread quickly within animal herds by direct contact or contaminated needles, clothing or equipment (Letchworth et al. 1999). Infected animals will salivate excessively and the saliva can contain 4 to 6 logs of virus per milliliter of saliva (Hanson et al. 1957) which can easily contaminate facilities and the environment. This allows for an efficient animal to animal or contaminated needles, clothing or equipment to animal transmission (Lord and Tabachnick, 2002). Outbreaks within the U.S. have a seasonal pattern with most occurring initially during the early summer and ending with the first frost which is the same seasonal pattern of important vectors of VSV.

Vectors of VSV have been divided into two groups: 1.) insects that are involved in mechanical transmission of VSV and 2.) insects that are involved in biological transmission of this virus.

Mechanical transmission by insects is typically characterized by physical viral transport and the absence of an incubation period within the insect (Ferris et al. 1955). Insects implicated in mechanical transmission of this virus include house flies, eye gnats, and grasshoppers (Francy et al. 1988; Drolet et al. 2009). High viral titers in the lesions on the skin and in the saliva is how most of these mechanical vectors pick up the VSV virus when they feed on or land near these sites on the animal.

Biological transmission by insects is characterized by being related to a specific species of insect that also has an incubation period in which the virus increases in the insect before it reaches transmission related organs such as the salivary glands or eggs of the insect (Roza-Lopez et al. 2018). Most seasonal occurrences of VSV are



Figure 2: Adult biting midge, *Culicoides sonorensis*, showing blood-filled abdomen and the characteristic wings patterns used for species identification. Photograph by Ed T. Schmidtman, USDA/ARS.

associated with insect vectors that are biologically transmitting the VSV and are located near running water or standing water. The two most common biological vectors are black flies which prefer to develop in running water and *Culicoides* biting midges which prefer standing or stagnant water (Schmidtman et al. 1999).



Figure 3: *Culicoides stellifer* with different wing patterns than *Culicoides sonorensis*. Photo Credit:CBG Photography Group, Centre for Biodiversity Genomics

Considering the time of year that this case of VSV was reported and the location in southwestern Oklahoma the most likely insect vector to potentially spread this disease are *Culicoides* biting midges. These midges are common in Oklahoma especially when standing water such as ponds start to form receding shorelines that produce mud which these midges prefer. The species that have been implicated in VSV transmission are *Culicoides sonorensis* (Fig. 2) and *Culicoides stellifer* (Fig. 3). Both are present in Oklahoma.

When considering where these two particular species develop and when they are most active a recent study at Oklahoma State University (Talley et al. unpublished) documented *Culicoides* spp. breeding and activity patterns. *C. sonorensis* is found in typical areas that it has been associated with historically (Holbrook et al. 2000) such as animal lagoons, creek mud associated with animals, and pond mud (Fig. 4). They are also actively seeking blood meals from animals between 8 pm to 10 pm and from 4 am to 5 am (Fig. 5). In contrast, *C. stellifer* were found in more diverse breeding habitats that included both animal lagoons and treeholes (Fig. 4). This can complicate control measures especially if your animals are located near trees that form tree holes where water can collect such as oak trees. Also somewhat different than *C. sonorensis* is that *C. stellifer* was active throughout the night not just during evening and early morning periods (Fig. 5). Looking at their seasonal pattern in Oklahoma both of these species are active from June to September (Fig. 6) which matches the pattern of VSV historical outbreaks especially in years that have limited stream flow and more soil moisture associated with water bodies (Elias et al. 2019). However, county records for these two species are lacking in the southwestern portion of Oklahoma.

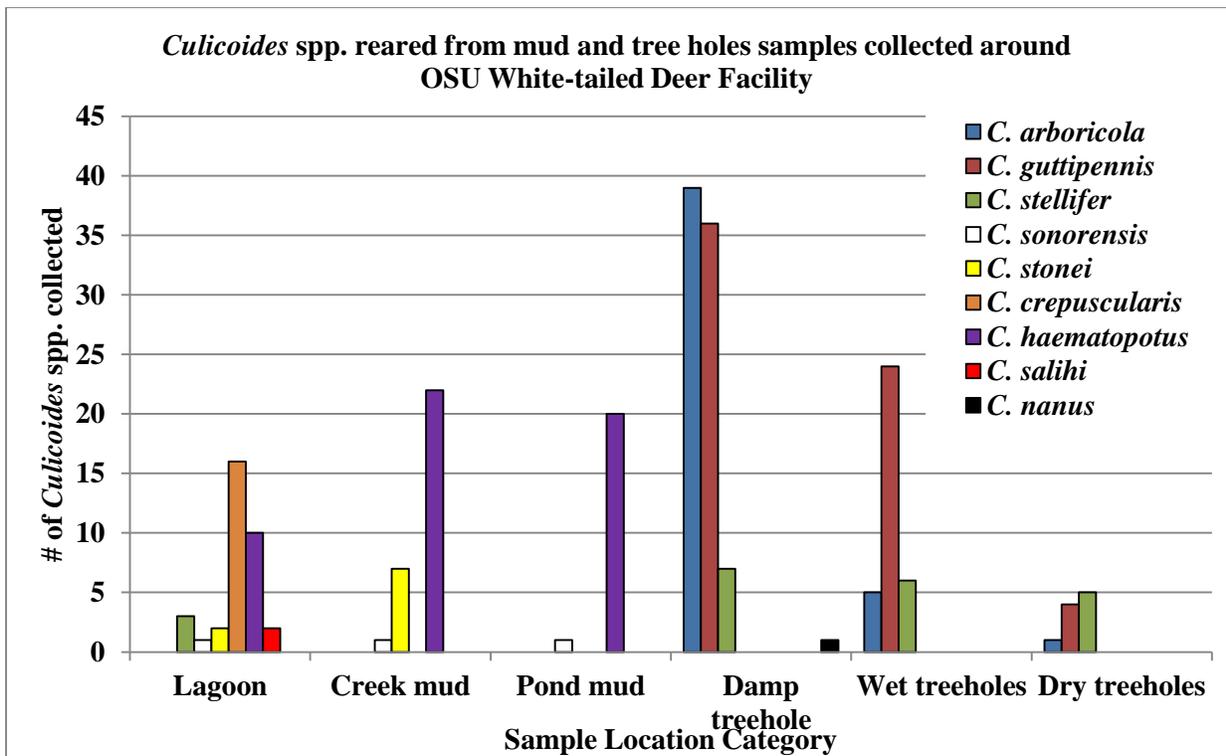


Figure 4: *Culicoides* spp., with sexes pooled, reared from mud and treeholes samples taken from sites around the OSU White-tailed deer research facility.

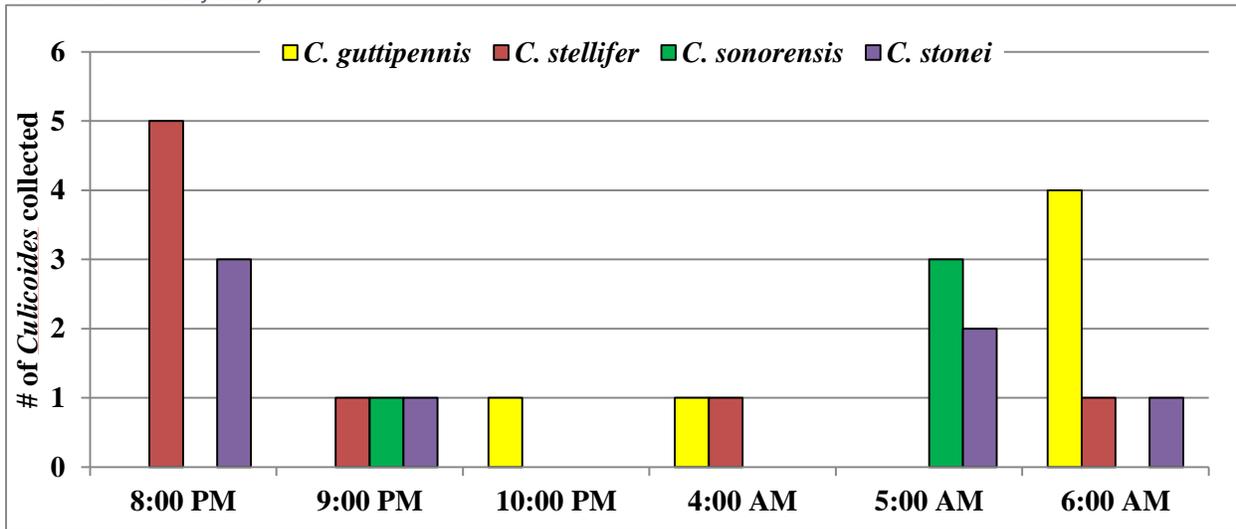


Figure 1: Female *Culicoides* collected by drop trap pooled on an hourly basis for the trap nights between 7/3/2013-9/12/2013. Collections took place only at the hours of 8, 9, 10 PM and 4, 5, and 6 AM. Only the four most commonly collected species are being represented on this graph.

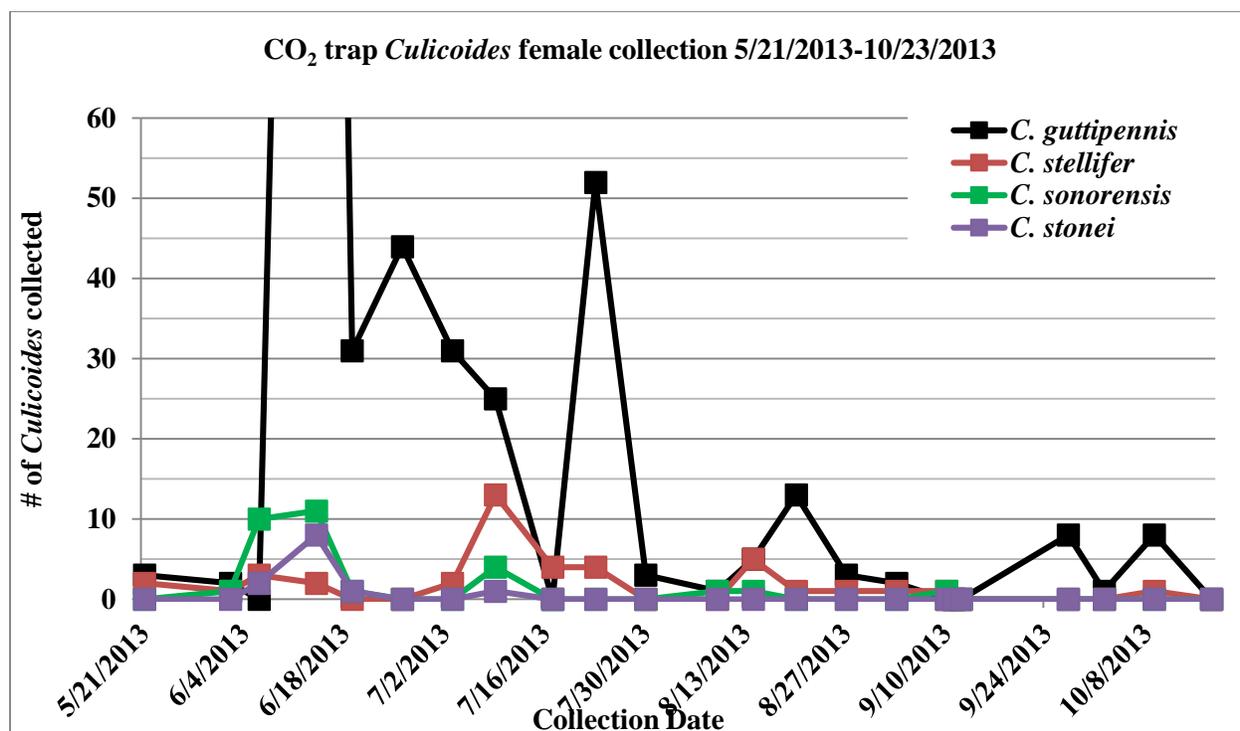


Figure 2: Collection data for female *Culicoides* midges collected during 5/21/2013 through 10/23/2013 using a CO₂ only baited suction trap. The data point for *C. guttipennis* on 6/14/2013 is 286 specimens collected.

In general, when considering the insects that can transmit VSV are associated with water, several studies have shown that animals closer to water have an increased probability of contracting VSV and in fact if animals are less than 1,300 feet away from water then they are twice as likely to have animals with clinical signs of VSV (Hurd et al. 1999; Elias et al. 2019). Even though black flies are considered an important vector of VSV recent work has indicated that they can only travel less than 3 miles from flowing water resources (Adler et al. 2010) which most likely implicates biting midges in Oklahoma. If this case occurred in late spring or early summer, then there were plenty of flowing water resources for the black fly but since the record flooding from earlier in the year has receded and the temperatures have increased then the most likely vector of VSV are biting midges. Interestingly, the *Culicoides* data from OSU indicates that not only should *C. sonorensis* be a concern but also *C. stellifer* which was found in higher numbers than *C. sonorensis* and has a more diverse habitat that includes treeholes that can retain water.

Recommendations:

- Increase biosecurity measures at farms and ranches
 - Including isolation of new introductions or animals that have traveled
- Contact the State Veterinarian at 405-522-6141 if you suspect VSV disease
- Locate animals away from flowing water or standing water
- Treatment of water is impractical but if suspected VSV is near your premises then using mosquito larvicides can aid in the reduction of some of these flies and midges but

products should not be applied to water sources that are flowing into other property owner's property

- Stable your horses at night and put a fan on them which would disturb the flight of both biting midges and black flies
- If you see skin welts along a horse's neck, then apply an insecticide along with a repellent to repel and kill biting midges
- Cattle should be treated with a pyrethroid insecticide because it will have some repellent properties as well as insecticidal
 - Whole body sprays would provide more protection but insecticidal ear tags will also repel some biting midges

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