

7.4 Bluetongue in Livestock

A warming climate can impact livestock directly by causing heat stress and indirectly by affecting vector-borne disease occurrence (IPCC, 2022). Bluetongue (BT) is a vector-borne viral disease of sheep, goats and cattle transmitted by biting midges of the arthropod genus *Culicoides*. BT infections cause high morbidity and mortality, primarily in sheep, but can cause illness of varying severity and reduced productivity in cattle, including decreases of milk production. Disease outbreaks can also influence international trade, movement of livestock, animal production and welfare, and can have major economic consequences; for example, in Ontario, Canada the detection of infected cattle in 2015 caused the immediate suspension of exports of live animals, semen, and embryos, valued at nearly 300 million Canadian dollars (Mann, 2015). US livestock industries' losses due to trade restrictions and testing for BT have been estimated between \$125 and \$144 million annually (USDA, 1999; Hoar, 2003; Tabachnick, 2020). In the United States, BT's greatest economic impact has historically been the cattle industry because it is larger than the domestic sheep industry and more affected by international trade restrictions (Bailey, 2014), although cases of infected sheep in California have also been reported (Gamsjäger and Chigerwe, 2024; Pérez et al., 2023).

Bluetongue occurs globally and is common throughout California with the highest and most consistent activity in the Central Valley, including both the Sacramento Valley and the San Joaquin Valley (Mayo et al., 2016; Moeller, 2016). The virus is maintained in areas where the climatic conditions allow the vector to survive over winter, and generally occurrence of BT parallels vector activity – increasing during periods of warm temperature and rainfall and subsiding in colder weather (WOAH, 2026). Although BT is endemic in the US, climate change may alter the transmission of this and other similar arthropod-borne viruses, increasing risks to both domestic and wild ruminants.

As discussed above, insects are sensitive to changes in temperature, suggesting they are likely to respond to climate change. Warming temperatures can alter the distribution of vectors and accelerate disease transmission (see the *Vector-borne diseases* chapter). BT incidents have expanded northward and persisted in Europe and Canada



and have extended farther south than the traditional range into Victoria, Australia. In the United States, eleven previously non-endemic serotypes of BT virus have been detected since 1999 (serotypes are groups within a single species of microorganisms, such as bacteria or viruses, which share distinctive surface structures) (Mellor et al., 2008; Jimenez-Clavero, 2012; Maclachlan et al., 2018). Some of these non-endemic serotypes are being detected farther away from the southeastern United States where they are usually confined, suggesting increase in distribution and potential for persistence (Schirtzinger et al., 2018). Researchers suggest the *Culicoides* vector is especially responsive to climate change (Purse et al., 2005 and 2008). In general, warm temperatures enhance the recruitment, development, activity and survival rates of *Culicoides* vectors. Scientists expect increases in temperature (particularly at night-time and in winter) as well as increased precipitation in dry areas, to expand the geographical and seasonal incidence of BT virus transmission. Investigators modeling the distribution of *Culicoides* in North America using future climate scenarios predict northward expansion of the vector beyond its current range in the northern United States and southern Canada, with increased risk of *Culicoides*-borne disease over the next several decades, particularly at the US-Canada border (Zuliani et al., 2015). The northward expansion of BT outbreaks in Europe in recent decades has been examined with climate-driven models that show increasing temperatures may explain aspects of this expansion (Guis et al., 2012) and predict a trend of increasing risk globally using future climate scenarios (Samy and Peterson, 2016). However, BT incidence is influenced by many factors, including vector ecology and transmission cycles, water availability, land use, and agricultural management, which hampers the ability to link climate change with disease outcome.

Research has continued on the ecology of the vector, and what climatic, environmental, and anthropogenic factors may affect disease transmission in California and in North America (Mayo et al., 2016 and 2020). A 3-year study (2018-2021) in a southern California dairy region found that the BT vector did not die off or go dormant during winter months, but that active adult host-seeking midges as well as developing stages were present and captured regularly on warmer days (Zhang and Gerry, 2023). These findings support that persistence of the bluetongue virus in the region through winter



can occur via continuous low-level transmission between *Culicoides sonorensis* and cattle hosts, and that warming temperatures could increase the risk of disease occurrence or spread throughout the year. This information will support direct risk assessment and targeted surveillance for presence of the virus, as well as potential mitigation strategies. Bluetongue occurrence in livestock is currently reportable to and monitored by the California Department of Food and Agriculture's [Animal Health Branch](#).

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References

- Bailey P (2014). UC Davis College of Agricultural and Environmental Sciences. [Solving The Bluetongue Disease Mystery](#). Retrieved June 2, 2026.
- Gamsjäger L and Chigerwe M (2024). Clinical presentation, medical management, and outcomes in 35 hospitalized sheep diagnosed with bluetongue virus disease. *Journal of Veterinary Internal Medicine* **38**(1): 514-519.
- Guis H, Caminade C, Calvete C, Morse AP, Tran A, et al. (2012). Modelling the effects of past and future climate on the risk of bluetongue emergence in Europe. *Journal of the Royal Society Interface* **9**(67): 339-350.
- Hoar Br, Carpenter TE, Singer RS, and Gardner IA (2003). Regional risk of exporting cattle seropositive for bluetongue virus from the United States. *American Journal of Veterinary Research* **64**(5).
- IPCC (2022). *Climate Change 2022 Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. The Core Writing Team, Pachauri RK, and Meyer L (Eds.). Intergovernmental Panel on Climate Change. Geneva, Switzerland.
- Jimenez-Clavero MA (2012). Animal viral diseases and global change: Bluetongue and West Nile fever as paradigms. *Frontiers in Genetics* **3**: 105.
- MacIachlan NJ, Zientara S, Wilson WC, Richt JA, and Savini G (2018). Bluetongue and epizootic hemorrhagic disease viruses: recent developments with these globally re-emerging arboviral infections of ruminants. *Current Opinion in Virology* **34**: 56-62.
- Mann S (2015). Better Farming. International markets react to bluetongue presence in Ontario. Retrieved March 30, 2017.



- Mayo C, McDermott E, Kopanke J, Stenglein M, Lee J, et al. (2020). Ecological dynamics impacting bluetongue virus transmission in North America. *Frontiers in Veterinary Science* **7**(186).
- Mayo C, Shelley C, MacLachlan NJ, Gardner I, Hartley D, and Barker C (2016). A deterministic model to quantify risk and guide mitigation strategies to reduce bluetongue virus transmission in California dairy cattle. *PLoS One* **11**(11): e0165806.
- Mellor PS, Carpenter S, Harrup L, Baylis M, and Mertens PP (2008). Bluetongue in Europe and the Mediterranean Basin: History of occurrence prior to 2006. *Preventive Veterinary Medicine* **87**(1-2): 4-20.
- Moeller RB (2016). *Factsheet: Bluetongue Virus*. University of California at Davis, Veterinary Medicine.
- Pérez E, Asín J, and Uza FA (2023). An outbreak of bluetongue in sheep. *Brazilian Journal of Veterinary Pathology* **16**: 148-151.
- Purse BV, Brown HE, Harrup L, Mertens PP, and Rogers DJ (2008). Invasion of bluetongue and other orbivirus infections into Europe: The role of biological and climatic processes. *Revue Scientifique et Technique* **27**(2): 427-442.
- Purse BV, Mellor PS, Rogers DJ, Samuel AR, Mertens PP, et al. (2005). Climate change and the recent emergence of bluetongue in Europe. *Nature Reviews Microbiology* **3**(2): 171-181.
- Samy AM and Peterson AT (2016). Climate change influences on the global potential distribution of bluetongue virus. *PLoS ONE* **11**(3): e0150489.
- Schirtzinger EE, Jaspersen DC, Ostlund EN, Johnson DJ, and Wilson WC (2018). Recent US bluetongue virus serotype 3 isolates found outside of Florida indicate evidence of reassortment with co-circulating endemic serotypes. *Journal of General Virology* **99**: 157-168.
- Tabachnick WJ, Smartt CT, and Connelly CR (2020). *Bluetongue*. ENY-743 IN768. EDIS. Gainesville, FL.
- USDA (1999). *The Bluetongue Triangle*. Agricultural Research, United States Department of Agriculture.
- WOAH (2026). World Organisation for Animal Health. [Bluetongue](#). Retrieved June 2, 2026.
- Zhang X and Gerry A (2023). Host-seeking activity of adult *Culicoides sonorensis* (Diptera: Ceratopogonidae) during winter in southern California, USA, and assessment of bluetongue virus overwintering. *Journal of Medical Entomology* **60**(4): 789-795.
- Zuliani A, Massolo A, Lysyk T, Johnson G, Marshall S, et al. (2015). Modelling the northward expansion of *Culicoides sonorensis* (Diptera: Ceratopogonidae) under future climate scenarios. *PloS ONE* **10**(8): e0130294.

