A model for Bluetongue disease dynamics in cattle

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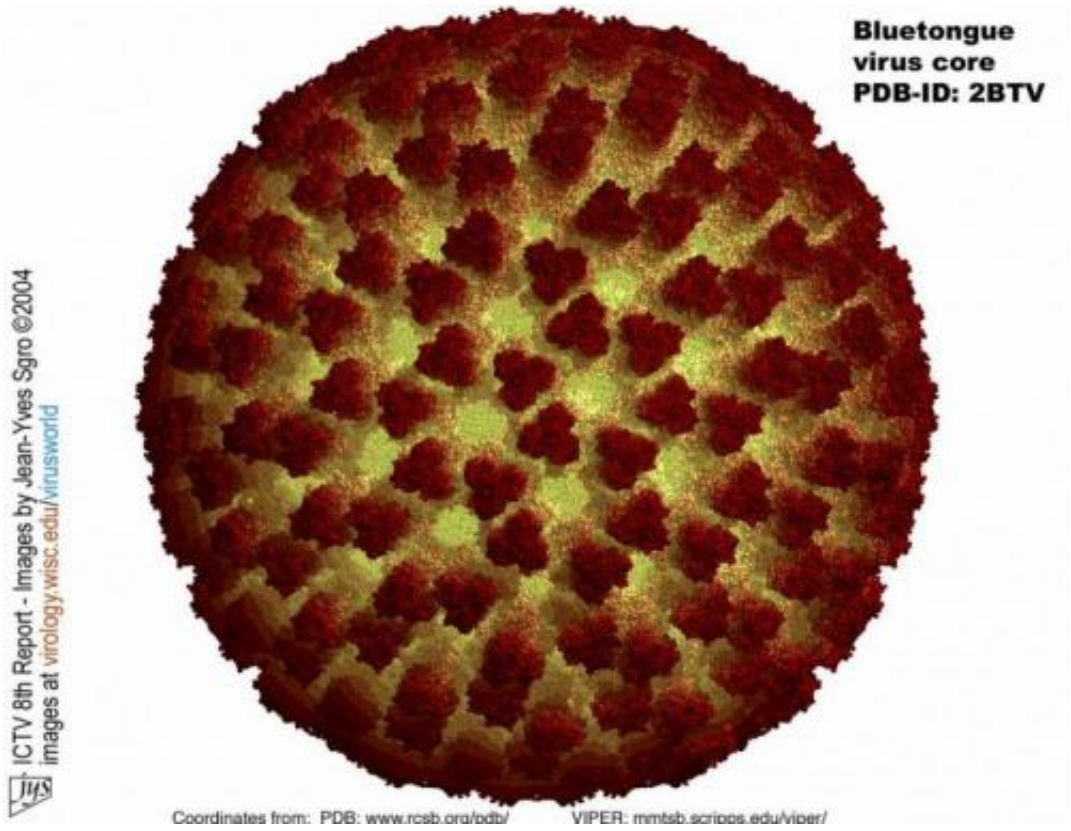

The atomic structure of the bluetongue virus core. Ramsol image of PDB 2BTV by Dr. J.-Y. Sgro, UW-Madison

In a paper recently published in the *SIAM Journal on Mathematical Analysis*, authors Stephen Gourley, Gergely Röst, and Horst Thieme model disease persistence of a virus called Bluetongue using a system of

several delay differential equations. The disease affects sheep and cattle, and is spread by biting midges. In sheep, the bluetongue virus can cause abortion, congenital abnormalities and death, though mild cases completely recover. In cattle, bluetongue does not generally cause death.

The basic reproduction number for a disease is defined as the expected number of secondary cases produced by a single infection in a susceptible population. As in many infectious disease models, uniform disease persistence of bluetongue occurs if the basic reproduction number for the whole system exceeds one. But an additional factor influences the disease state in the case of this disease, which is that it affects sheep much more severely than cattle.

As a result, uniform disease persistence can occur in two different scenarios. If the disease reproduction number for the cattle-midge-bluetongue system with or without sheep is greater than one, bluetongue persists in cattle and midges even though it may eradicate the sheep, relying on cattle as a reservoir. In the second situation, where the reproduction number of all host and vector species coexisting is greater than one, while the reproduction number for the cattle-midge-bluetongue system (without sheep) is less than one, bluetongue and all host and vector species coexist, and bluetongue does not eradicate sheep because it cannot persist on midges and cattle alone.

The authors use different approaches of dynamical systems persistence theory to analyze the two situations.

More information: Uniform Persistence in a Model for Bluetongue Dynamics, *SIAM Journal on Mathematical Analysis*, 46 (2), 1160-1184

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