# Text S1

# Sensitivity study for the extrinsic incubation period and C. obsoletus models

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## Sensitivity study for the extrinsic incubation period

In this study the extrinsic incubation period is expressed by its reciprocal, the virus reproduction rate $\gamma_M(T)$. Available functional relationships are depicted in Figure S1. The sensitivity of the basic reproduction number $R_0$ concerning the application of different temperature dependent functions $\gamma_M(T)$ is depicted in Figure S2. The sensitivity of the Bluetongue risk assessment regarding alternative extrinsic incubation periods is low.

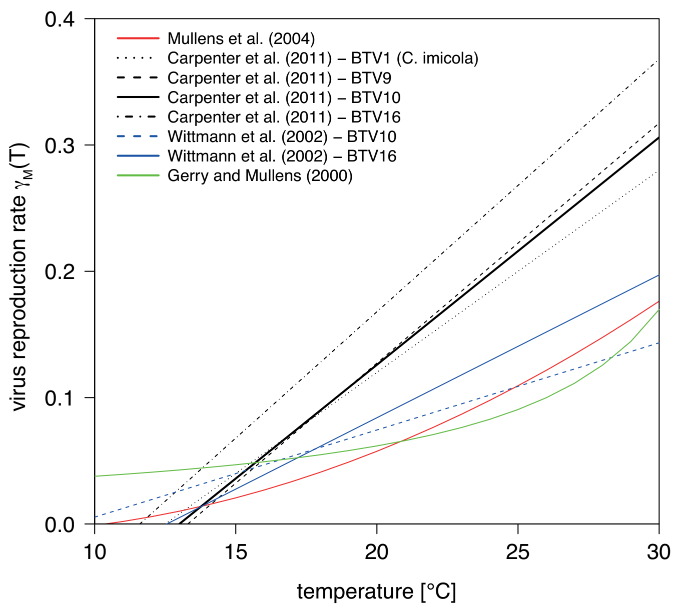


**Figure S1:** Temperature dependent virus reproduction rates $\gamma_M(T)$. In red after [1], in black after [2], in blue after [3], and in green after [4].

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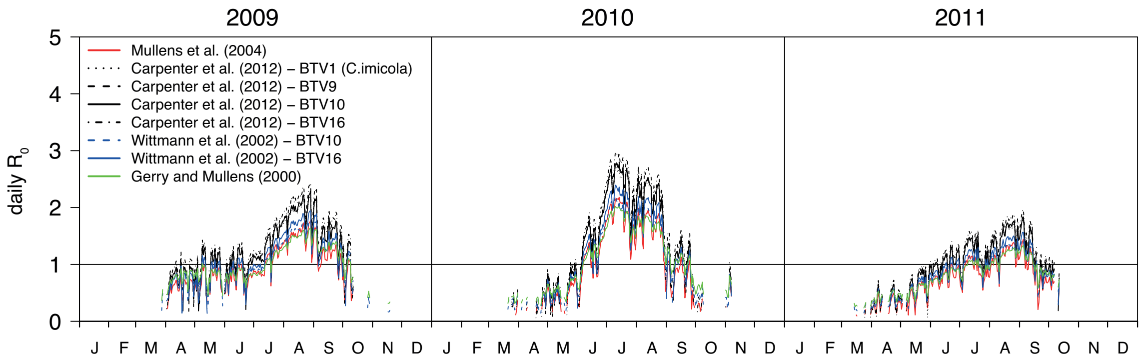


**Figure S2:** Simulated daily $R_0$-values for the different virus reproduction rates $\gamma_M(T)$. Location Vienna, period 2009-2011.

## Sensitivity study for *C. obsoletus* models

Alternatively, two linear regression models were applied to simulate *C. obsoletus* densities in unsampled regions. The first, a Poisson regression model, gives an accurate estimate of the mean but underestimates the variance. The second, a Negative Binominal regression model, avoids overdispersion but overestimates the mean (Table S1). In this study we prefer the first one. A comparison of Figures 5 and S3 demonstrates the minor impact, i.e. the low sensitivity, of the *C. obsoletus* model on the Bluetongue risk assessment. The verification of the Poisson model results in a sensitivity of 0.81 and a specificity of 0.53. Applying the Negative Binomial model leads to a slightly higher sensitivity of 0.89, but a lower specificity of 0.43.
The formula for the Negative Binomial model reads as follows

$$log_e(n_i + 1) = -1.4991 + 0.0986\ T_{i,i} + 0.1296\ \overline{T}_{i-37,i} + 1.1658\ \overline{P}_{i-100,i-16}\ , \qquad (1)$$

with the daily temperature $T$, the mean temperature $\overline{T}$, and the mean logarithmic precipitation $\overline{P}$ (all coefficients significant with $p < 0.001$).

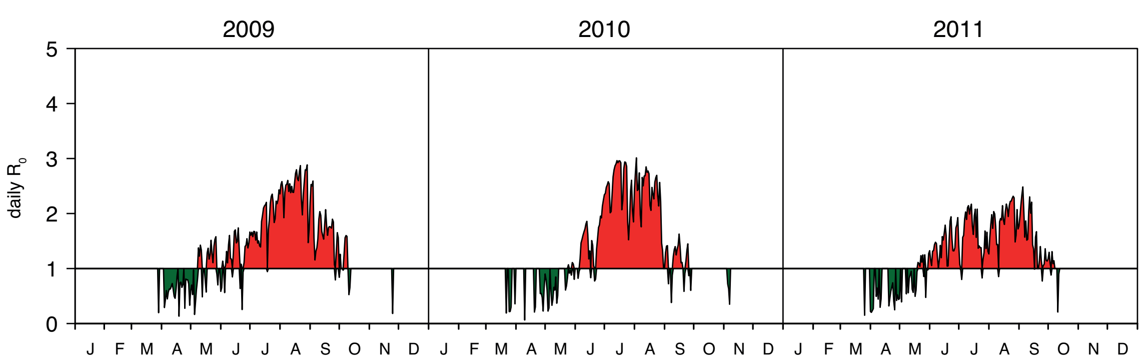


**Figure S3:** Simulated daily $R_0$-values based on standard parameters and *C. obsoletus* densities estimated by the Negative Binominal regression model. Location Vienna, period 2009-2011.

| | mean | variance |
|---|---|---|
| observed midges | 14.92 | 959.91 |
| simulated midges - Poisson regression | 14.92 | 438.88 |
| simulated midges - Negative Binominal regression | 19.38 | 830.17 |

**Table S1:** Mean and variance estimated by the Poisson and the Negative Binominal regression model.

## References

1. Mullens B, Gerry A, Lysyk T, Schmidtmann E (2004) Environment effects on vector competence and virogenesis of bluetongue virus in culicoides: interpreting laboratory data in a field of context. Veter Ital 40: 160-166.

2. Carpenter S, Wilson A, Barber J, Veronesi E, Mellor P, et al. (2011) Temperature dependence of the extrinsic incubation period of orbiviruses in culicoides biting midges. PLoS ONE 6: e27987.

3. Wittmann EJ, Mello PS, Baylis M (2002) Effect of temperature on the transmission of orbiviruses by the biting midge, Culicoides sonorensis. Med Vet Entomol 16: 147-156.

4. Gerry A, Mullens B (2000) Seasonal abundance and survivorship of *Culicoides sonorensis* (Diptera: Ceratopogonidae) at a sousouth California dairy, with reference to potential bluetongue virus transmission and persistence. J Med Entomol 37: 675-688.