

Quantification of transmission (R_0) of bluetongue virus serotype-8 within dairy herds based on serological field data

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Aim of the study

The goal of the study was to determine the basic reproduction rate (R_0) of BTV-8 between Dutch dairy cattle in the 2007 BTV-8 epidemic.

Material & Methods

Data

In 2007, a sentinel network was initiated to monitor the circulation of BTV-8 in the Netherlands. In May, 275 dairy herds were selected across the Netherlands and seronegative cows were tested each month for antibodies in their milk. The percentage of seroconversions per herd per month was derived (Figure 1) the R_0 of the infection could be determined.

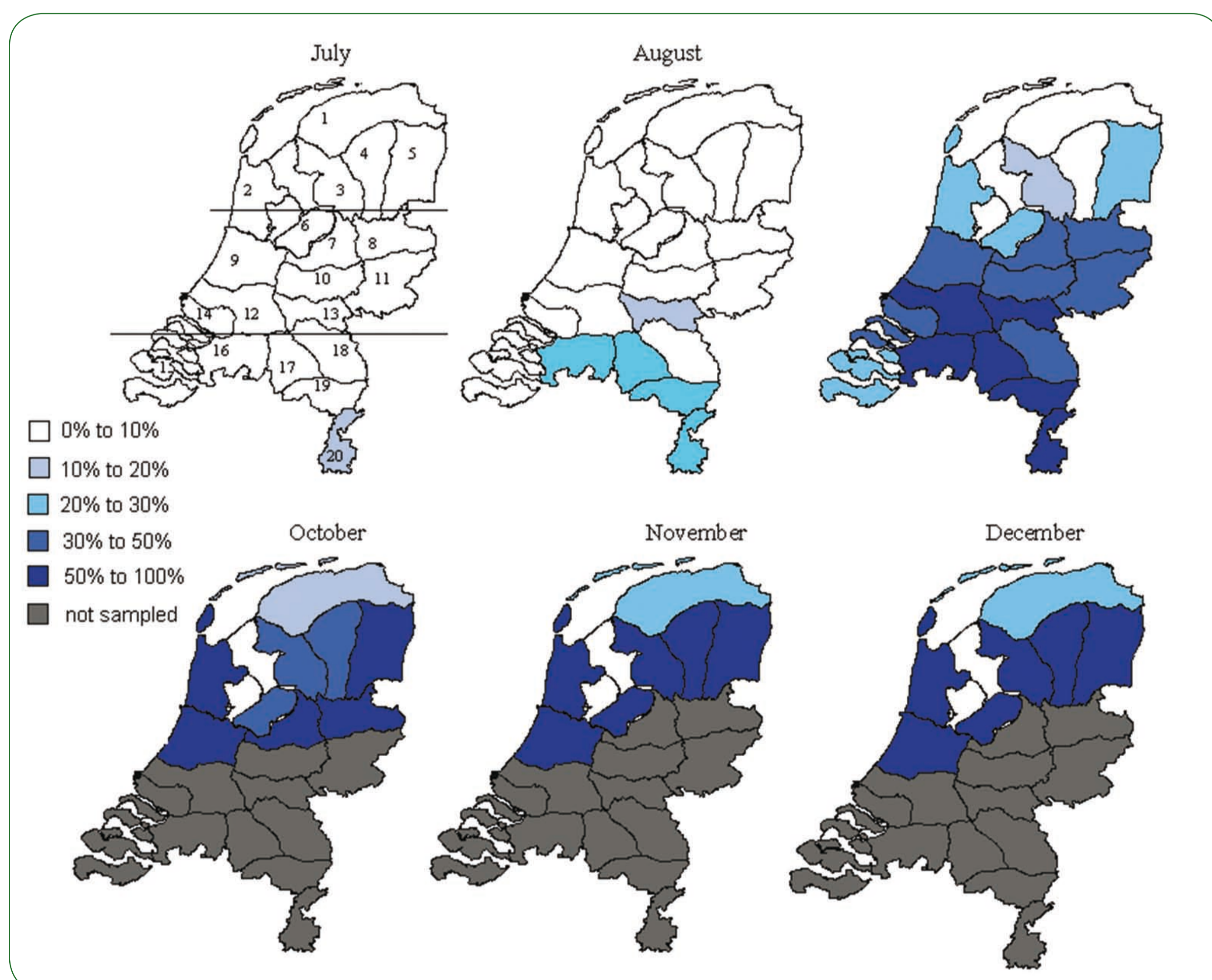


Figure 1. Average within-herd BTV-8 seroprevalence in the Netherlands. Horizontal lines in the first map represent the region North, Central and South.

Model

The cattle population per time t was divided into three subclasses of cows that were susceptible, infectious or recovered. The proportion recovered cows was derived from the field data as the proportion of seropositive cows for each dairy herd per measurement at time t . These seropositive cows became seropositive after an infectious period which was caused by being bitten by an BTV-8 infectious vector (Figure 2).

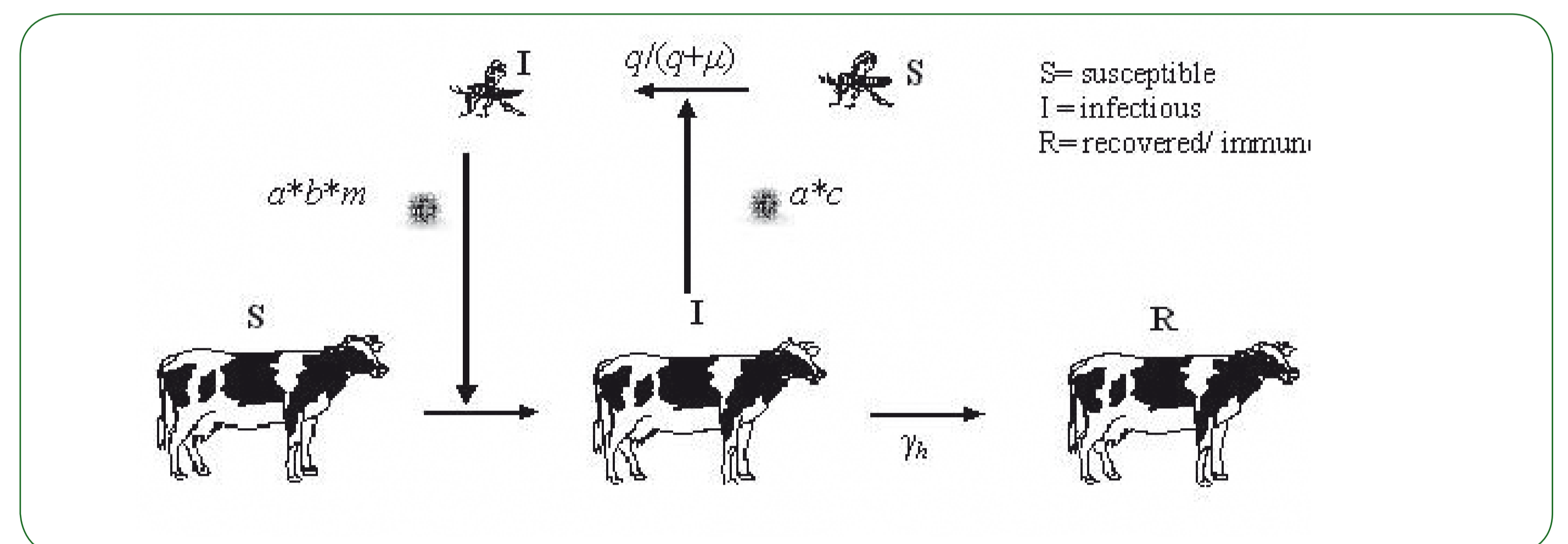


Figure 2. Description of the transmission route of BTV-8.

- a biting rate per day
- b effectiveness transmission from vector to host
- c effectiveness transmission from host to vector
- m number of *Culicoides* per day
- γ_h recovery rate per day
- $q/(q+\mu)$ P to survive the incubation period q is P to leave the incubation state and μ is the mortality rate

Results

The mean between-cattle R_0 in the Netherlands in 2007 was 3.8 (95% CI: 3.5-4.1). Overall median R_0 values were highest between August and October (3.5). However, per region (south, central or north) the month in which the R_0 value was highest differed (Figure 3).

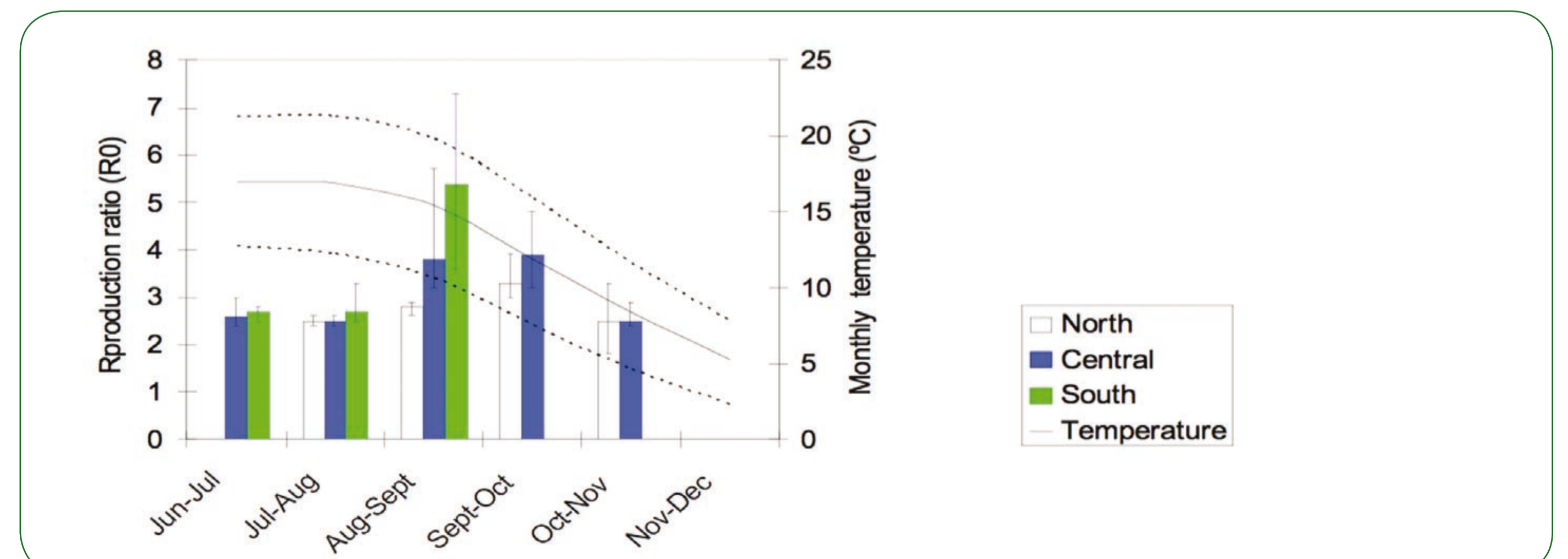


Figure 3. Median and inter quartile range of R_0 per month from June until December 2007 for region north, central and south within Dutch dairy herds.

Conclusion

The transmission of BTV-8 is highly dependent on outside temperature. Nevertheless, during the 2007 BTV-8 epidemic in the Netherlands, one BTV-8 infectious cow could infect on average 3.8 other cattle by bites of *Culicoides*. This R_0 seemed to represent the within-herd spread of BTV-8 in the field well and these transmission rates could apply to other countries in which BTV-8 emerges, given a similar climate, grazing patterns and barn types as in the Netherlands.

Acknowledgements

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