Veterinærinstituttet
National Veterinary Institute

Meteorologisk institutt
met.no

Agriculture and Agri-Food Canada
Agriculture et Agroalimentaire Canada

Simulating risk of bluetongue epidemics in Norway

Petter Hopp[1], Hans Olav Hygen[2], Inger Sofie Hamnes[1], Tim Lysyk[3]

1 National Veterinary Institute, Oslo, Norway
2 Norwegian Meteorological Institute, Oslo, Norway
3 Agriculture and Agri-Food Canada, Lethbridge Research Centre, Lethbridge, Alberta, Canada

Introduction

Cattle positive for bluetongue (BT) virus were detected in four Norwegian herds in February 2009. The BT-virus was probably introduced during fall 2008. No BT epidemic developed.

BT epidemics are dependent on

- the density of the vector
- the weather and in particular the temperature
- the density of susceptible animals

Norway has areas belonging to the temperate, continental and polar climatic zones. Therefore, temperature is expected to be a limiting factor of a BT epidemic for at least parts of Norway.

The aim of this study was to evaluate the risk of BT epidemic in Norway by applying a model that simulates the risk of bluetongue transmission under Norwegian temperature conditions based on the effects of temperature on development of the virus in the vector (extrinsic incubation period, EIP) and the biting frequency of *Culicoides*.

Material and Methods

A deterministic simulation model was used (1).

The model assumptions were:

- transmission occurs when the midge feeds on blood
- the midge feeds on blood at the start of each ovarian cycle
- the EIP must be completed before transmission can occur

Model output

- minimum number of days for the EIP
- minimum number of ovarian cycles needed before virus transmission was possible

The rate of development of the virus in the midge rEI(T) was given by:

$$rEI(T) = 0.0003*T*(T-10.4057)$$

The rate of the midge's ovarian development was given by:

$$rOD(T)=0.000171*T*(T-3.6966)*(41.8699-T)^{1/2.7056}$$

where T = temperature (°C).

Epidemics are most likely when the EIP ≤ 17 days and the number of ovarian cycles needed for transmission ≤ 3.

The model was run with the 1st of August as starting date. Data from 2003 to 2009 for all weather stations south of 61 degrees latitude with hourly observations of temperature (2) were included in the analysis.

Results

The EIP is presented in figure 1. For all locations with EIP $\leq$ 17 days, the number of ovarian cycles needed for transmission was larger than 3.

Conclusions

The results suggest that in certain years a BT-epidemic might develop in areas located along the southern coast or eastern part of Norway.

The fact that the model predicted the possibility of a BT-epidemic in Norwegian areas for only two of the seven years included into the simulation, indicates that Norway is on the borders of the extension of BT-virus.

The model is based on data from *C. sonorensis* and data specific for *Culicoides* species transmitting BT in Northern Europe is needed.

Although temperature might be the main factor limiting BT epidemics in Norway, the low density of ruminants in large areas of Norway might reduce the possibility of BT epidemics even further.

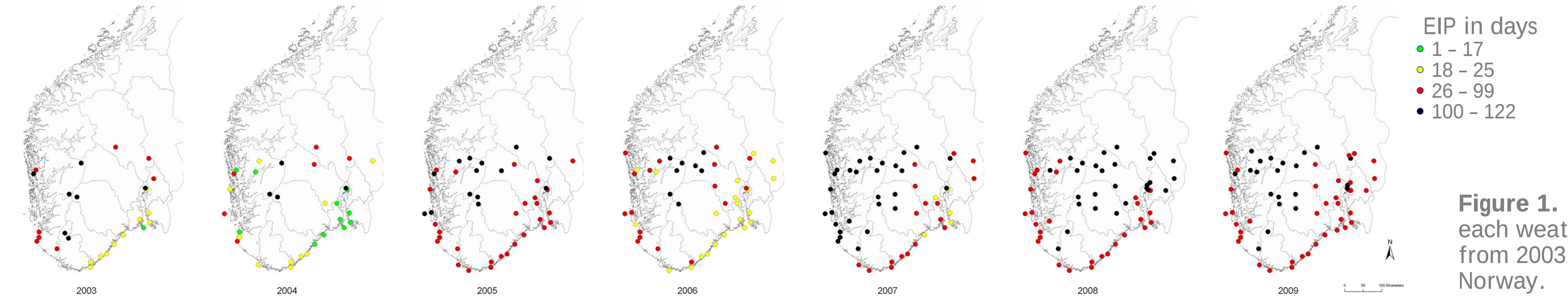

Figure 1. EIP as estimated for each weather station per year from 2003 to 2009 in Southern Norway.

Acknowledgements

The authors thank Chiek Er at the National Veterinary Institute Oslo for producing the maps.

References

1) Mullens BA, Gerry AC, Lysyk TJ & Schmidtmann ET, 2004. Environmental effects on vector competence and virogenesis of bluetongue virus in Cullicoides: interpreting laboratory data in field context. Veterinaria Italiana 40: 160-166.

2) Temperature data from Norwegian Meteorological Institute, available at eklima.met.no