

## Bluetongue virus is 'on-the-move'



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**Bluetongue virus is 'on-the-move'. The distribution of this important arthropod-borne pathogen of sheep and cattle is expanding rapidly, particularly in Europe, where its emergence and spread during the past decade have had severe economic consequences. The movement of bluetongue virus into new temperate European habitats appears to have been driven, at least in part, by global warming. Record summer temperatures, warmer winters and changes in precipitation patterns are believed to have provided the conditions necessary for more northerly seasonal spread, over-wintering and adaptation of the virus to new insect vectors. The emergence of bluetongue disease in Europe since 1998 has resulted in the deaths of more than two million sheep. The economic impact in France alone in 2006-07 was estimated to have already exceeded \$1.4 billion, mostly in lost trade. These events have significant implications for Australia, where freedom from disease and favourable terms of trade rest on a potentially fragile ecological balance between viruses, hosts and vectors.**

Bluetongue virus (BTV) is an orbivirus that infects ruminants and is transmitted by biting midges (*Culicoides* spp.). The BTV genome comprises 10 segments of double-stranded RNA (dsRNA). There are 24 described BTV serotypes and significant antigenic variations occur within serotypes. In sheep, BTV causes an acute haemorrhagic disease. Bluetongue disease can also occur in cattle and other ruminants, but infection is usually sub-clinical and cattle commonly act as a reservoir host. BTV occurs in all continents, other than Antarctica, but the range of serotypes and the vector species vary geographically. As for other arthropod-borne viruses, the biology of BTV infection and epizootiology of bluetongue disease are influenced by weather and climatic conditions. Temperature and humidity can affect fecundity, survival rate, blood-feeding frequency and the endemic distribution range of the vector, the rate of virus replication in the vector and the competence of the vector to

transmit the virus; rainfall can affect the availability of potential vector breeding sites; and wind can influence the dispersal of vectors within and beyond the endemic distribution range. As a consequence, the prevalence and distribution of bluetongue disease can vary seasonally and both are susceptible to changes in climate associated with global warming<sup>1</sup>.

Prior to 1998, bluetongue disease occurred rarely in Europe. Incursions were brief and did not extend beyond Spain, Portugal and the Greek Islands, which lie within the northern limit of the major Old World vector species, *Culicoides imicola*. However, during the past decade, several BTV serotypes have swept in from the Middle-East and Africa, causing epidemics across most of southern Europe from the Balkan states to France and Spain. Many serotypes have now become endemic in southern Europe as a result of a greatly expanded distribution of *C. imicola* and the involvement of new local vectors including *Culicoides obsoletus* and *Culicoides pulicaris*. The establishment of BTV and its principal vector in southern Europe and adaptation to local vectors, have been attributed to changes in precipitation patterns, warmer winters and higher average night-time temperatures associated with global warming.

Although the situation in southern Europe had been long predicted, the emergence of bluetongue north of the Alps since 2006 was somewhat more alarming<sup>2</sup>. BTV-8 first appeared in the Netherlands in the mid-summer of 2006 and by October had spread to France, Germany, Belgium and Luxembourg. The virus over-wintered and is now endemic in the UK, Scandinavia and across much of northern Europe, reaching into Spain in the south-west and as far eastwards as Hungary. The introduction of BTV-8 into northern Europe coincided with summer temperatures that were significantly higher than any time in recorded history. Although the immediate source is unknown, the virus has its origins in sub-Saharan Africa and the introduction probably involved imported cattle or midges<sup>3</sup>. However, the distribution of BTV-8 now lies well beyond the range of *C. imicola* and has involved adaptation to local cool-climate vectors such as *Culicoides dewulfi* and *C. obsoletus*. The BTV-8 epidemic in Europe is also characterised by disease and mortalities in both sheep and cattle. There is also evidence of persistence and trans-placental transmission in cattle, providing a possible mechanism of overwintering.

BTV has been known to be endemic in tropical and subtropical regions of Australia since it was first detected in 1978. Ten BTV serotypes have been identified but there has been no report of naturally occurring disease in cattle, sheep or other ruminants<sup>4</sup>. The primary vectors in Australia are *Culicoides brevitarsis* and *Culicoides wadai* (breeds in cattle dung), *Culicoides fulvis* (larval habitat unknown) and *Culicoides actoni* (breeds in rotting fruit). Although not the most efficient of

vectors, *C. brevitarsis* is highly abundant and has a wide distribution across northern and eastern Australia, extending to the coastal plains of central New South Wales. A similar constellation of BTV serotypes and vectors is also present in Southeast Asia and serological and genetic evidence suggests that new BTV incursions from Asia occur regularly, perhaps annually. The pathway of entry is likely to be via insect vectors carried on tropical monsoonal winds.

The absence of bluetongue disease in Australia appears to be due to the convergence of several favourable factors including:

- i) limitations on the distribution range of vectors determined by temperature, humidity and breeding habitat
- ii) the low virulence of Australian BTVs for cattle
- iii) the relatively low number of sheep in northern and eastern regions in which vectors are located
- iv) the relatively poor efficiency of vectors at the southern margins of BTV distribution where seasonal exposure of sheep can occur.

However, this is a potentially fragile ecological balance that we cannot assume to be stable. The recent events in Europe have demonstrated the potential for climate change to drive a sweeping expansion of the endemic distribution of bluetongue viruses and vectors, adaptation to new vectors and the establishment in new regions with climatic conditions previously considered unsuitable.

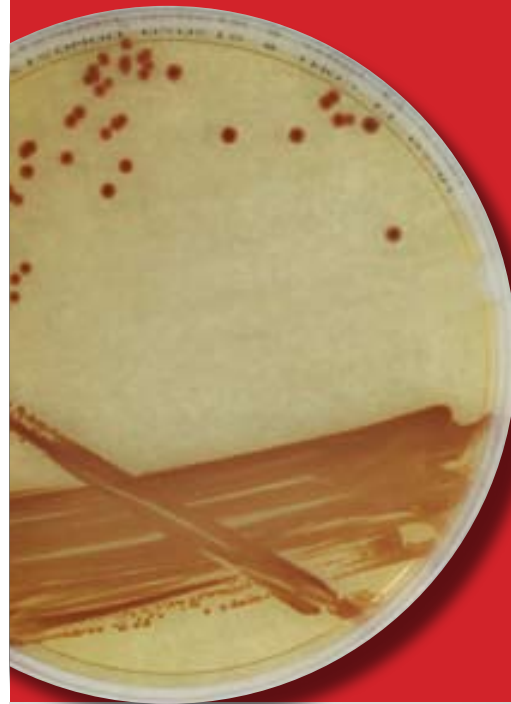
Ongoing surveillance of BTV activity and vector distribution in Australia, conducted primarily through the National Arbovirus Monitoring Program (NAMP), provides a vital basis of support for the live export trade and early warning of potential disease risks. However, the magnitude of the risk to Australia's livestock production and terms of trade presented by either the emergence of BTV in cattle or the spread of BTVs into sheep grazing lands, is substantial and the factors that could disturb our disease-free status are not sufficiently well understood. There are many important questions that cannot be answered adequately with our current state of knowledge and it is important that research continues to better understand the virus-vector-host dynamics and the potential impacts of global warming that could disturb that potentially fragile balance.

## References

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