International Animal Health Division

International Animal Disease Monitoring

Preliminary Outbreak Assessment

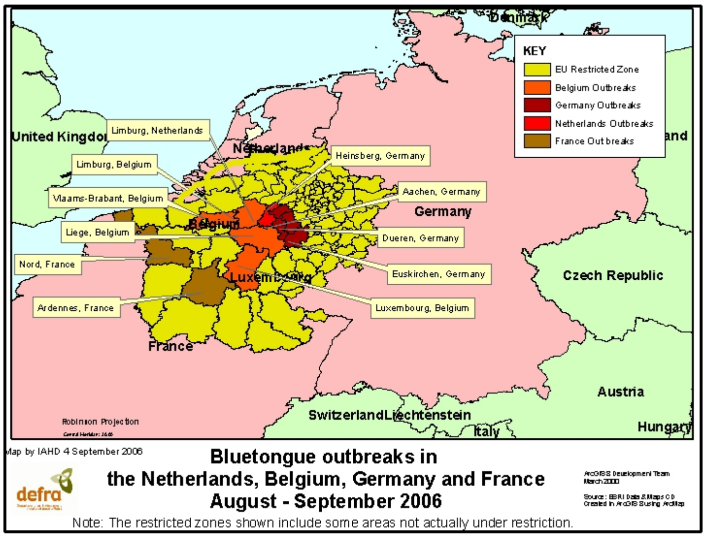
Ref: VITT 1200/BT – The Netherlands
Date: 6 September 2006

Bluetongue in the Netherlands, Germany, Belgium and France – An update

Note: *Defra's International Animal Health Division (IAHD) monitors outbreaks of high impact diseases around the world. Bluetongue (BT) is among those diseases of major concern.*

1 Disease Report

On 18 August 2006, the Netherlands reported an outbreak of Bluetongue (BT) in sheep on four farms located in the province of Limberg (southern Netherlands) close to the borders with Germany and Belgium (see map). Subsequently, the Netherlands, Belgium, Germany and France have also reported a number of clinical cases of BT in cattle and sheep holdings As of noon 4 September 2006, the Netherlands had reported 34 outbreaks, Belgium 67 outbreaks, Germany 43 outbreaks and France 3 outbreaks. The infected premises appear to be clustered within the established restricted zone. Further developments are likely.

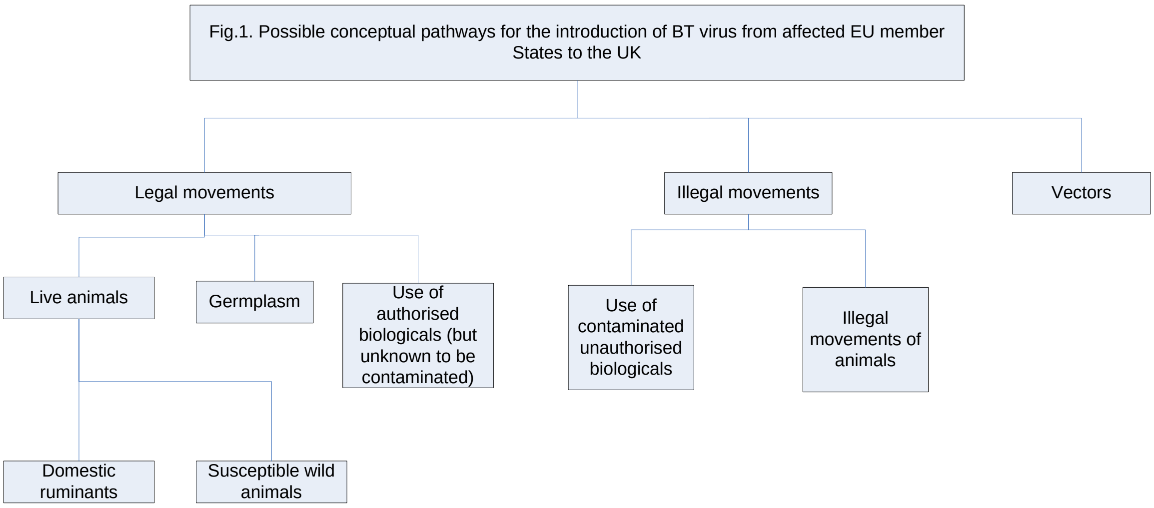


The virus was typed as BTV serotype 8 by the European Community Reference Laboratory for BT, Pirbright, UK on 26 August 2006.

2 Situation assessment and commentary

These new developments in the affected EU Member States raise a number of questions related to the introduction of the virus and its subsequent spread in the affected Member States. An understanding of these processes is needed in order to take actions that are proportionate to the risk of further spread. This is often the most difficult task to accomplish in any outbreak of any disease.

There are broadly three major streams of pathways (routes) by which BTV can be introduced from affected EU Member States to the UK (Fig.1).



These pathways have been considered in the context of basic epidemiological principles with regard to the virus, susceptible host and the environment.

2.1 The virus

BT virus (BTV) is an orbivirus that belongs to the *Reoviridae* family. Twenty four immunologically distinct serotypes (BTV 1 to BTV24) of the virus have been recognised to date. Various serotypes of the BT virus are found in the Americas, Africa, southern Asia and northern Australia. Epizootics of BTV serotypes 1, 2, 4, 9 and 16 have been recorded in southern Europe.

The BTV involved in the current outbreaks in the affected EU Member States is serotype 8. This is a significant epidemiological development because this type of the virus has never been recorded in Europe before. BTV serotype 8 (BTV-8) has been reported from Kenya, Nigeria, South Africa, and South and Central America (Institute for Animal Health, 2006; Mo and others 1994), and India (Daniels and others, 2004) but has never been reported from other parts of the world. This is the first time that this serotype has been officially reported outside sub-Saharan Africa, the Americas or India. This type of BTV has been shown to be capable to cause clinical signs in both infected cattle and infected sheep.

2.2 The host

BT disease factsheet is available at the following Defra website:
http://www.defra.gov.uk/animalh/diseases/notifiable/disease/bluetongue.htm

The maximum infectious period for animals infected with BT virus has been determined to be 60 days (OIE, 2006). It is generally considered that improved breeds of domestic sheep may show clinical signs of infection while domestic cattle act as a maintenance host and rarely exhibit clinical signs. However, Gerdes (2004) suggests that immunologically naïve cattle may sometimes experience clinical disease characterised by stomatitis, coronitis, lacrimation, salivation, nose and teat sloughs and sometimes haemorrhagic diarrhoea. While morbidity and mortality were low, a marked drop in milk production was noted.

BTV infects both domestic and wild ruminants (FAO, 2006, Eisa and others, 1979). Antibodies for BTV were also detected in approximately 55% of blood samples collected from free-range black and white rhinoceroses in Africa (Fischer-Tenhagan and others, 2000). They were also detected in wild carnivores and rodents, although their significance remains unknown (Haigh and others, 2002).

EU rules do not allow the import of live domestic animals from countries where BT is present. Import of zoo animals may be allowed under conditions specified by an importing EU Member State. We understand that further epidemiological investigations are underway in each of these areas.

BTV may be present in semen of bulls and be shed intermittently during the concurrent viraemia following infection. Infected bulls may be classified into three categories: those from which virus could not be isolated from the semen (the majority); those from which only low titers of virus were isolated on less than three occasions; those which shed virus over a two to three week period. Experimental studies demonstrated that approximately 30% of susceptible heifers inseminated with the BTV-contaminated semen have become viraemic. While significant importance has been attributed to reports of a bull that was persistently infected but seronegative from birth and intermittently shed virus in semen over an 11-year period, any subsequent attempts to duplicate the conditions that produce persistently BTV-infected, seronegative calves have been unsuccessful (various authors cited by Kitching, 2006).

The EU has adopted safeguard measures in the Netherlands, Belgium, Germany and France. These measures also include the whole of territory of Luxembourg even though no cases of the disease have been detected there. The affected Member States have imposed restricted zones around the outbreaks as required by EU rules: a standstill zone of 20km in radius from infected premises; a protection zone of 100km in radius from infected premises and a surveillance zone of 150km in radius from infected premises. These zones take into account the entomological, ecological, geographical, meteorological and epidemiological situation specific to each country. Movements of species susceptible to BT (including their semen, ova and embryos) out of the affected area have also been banned.

Even when EU rules for trade in ruminants are fully complied with, there is an inherent risk of susceptible hosts being consigned in good faith from a holding or region where disease is present but undetected. Member States of the EU must implement laws on disease surveillance, notification and control which minimises the likelihood of this happening but it can never be eliminated.

On the basis of initial epidemiological information, we have traced forward consignments of susceptible animals (since mid July 2006) and their germplasm (since 1 May 2006) that have been sent from the whole territory of the affected EU Member States to the UK. So far, no evidence of the virus has been identified in any of these consignments on clinical or laboratory grounds.

2.3 The environment

2.3.1 Geographic (spatial) spread

The outbreaks in the Netherlands, Germany, Belgium and France are a significant development in the epidemiology of BT because, in Europe, the virus has not previously been reported in areas beyond 50^0 North, latitude. Preliminary epidemiological investigations suggest that the disease may have been introduced to the affected area by June 2006. It remains unknown whether this was a single introduction or multiple introductions at approximately the same time.

To date, all detected cases in the affected EU Member States appear to be clustered within the 50km in radius from the first detected infected premises in the Netherlands. Surveillance outside restricted zone of 150km in radius have not detected any new infected premises so far, suggesting that the initial introduction may be recent, resulting in local spread of the disease within the limited area.

What appears to be the slight spread of the virus to the south and east of the initially affected areas in Germany now means that the confluent restricted zone has now expanded to 50km and further restriction zones have now been created in neighbouring parts of northern France.

2.3.2 Vectors

The likelihood that a susceptible animal will become infected with the BTV will depend on the biting rate of the vector on the animal and the infection rate in the vectors. The likelihood that a vector will become infected by feeding on an infected animal and, be able to transmit will depend upon, the quantity of the virus in the blood of the donor animal, the conditions for virus propagation in the vector (i.e. temperature), the susceptibility rate of the vector population and the survival rate of the vectors.

BT virus is a vector-born pathogen with the midge, *Culicoides imicola*, being the usual vector in most of the Old World, though it has not been found in any of the currently affected areas in NW Europe. It has been shown that meteorological and climatic conditions can affect the spread and establishment of the disease (Purse et al 2005). *Culicoides imicola* requires temperatures in excess of approximately 12^0C for long term survival. Virus replication in the insect requires temperatures in excess of 15^0C. During the period 1 June to 31 August 2006 maximum daytime temperatures in the infected area would have exceeded 25^0C on 37 occasions.

This midge, *Culicoides imicola*, is not present in the UK and it is believed that it is unlikely to establish because of climatic constraints. However, there are other potential BTV vector species of *Culicoides* that are widespread through the UK and central and northern Europe (i.e. midges of the *C. obsoletus* and *C. pulicaris* groups), although the competence of these species as vectors has only been demonstrated in the laboratory. Whilst the competence levels of *C. obsoletus* and *C. pulicaris* species of midge for BT virus were previously considered to be poor in comparison with *C. imicola*, recent research has found clear evidence that this is not always the case. This trait is inheritable and hence some populations of these species of midges are likely to be efficient vectors. This is the situation in the UK and is likely to be the case in Europe. In the field, there has been indirect evidence incriminating these species of midge in some outbreaks in the Balkans and in Italy. No *C. imicola* could be found in areas of the Balkans in the face of outbreaks of disease. Multiple isolations of BTV have recently been made from both of these species in the field in Italy (Savini and others, 2003, Caracappa and others 2003).

Both male and female *Culicoides* midges feed on nectar, however, females also need to feed on blood to enable their eggs to mature. Depending on the species, females may produce between 25 to 110 eggs per blood meal. Larvae require water, air and food and cannot develop without moisture. They are present in and around salt-marshes and mangrove swamps, the shores of streams and ponds and in other muddy substrates in and around farmyards. The larvae feed on small organisms. Most species cannot exist more than a few inches below the air-water interface (Rutledge, 2005).

The complete cycle of the midge from egg to larva to pupa to adult occurs within two to six weeks depending on the species and the environmental conditions. Male midges usually emerge before females and are ready to mate when the females emerge from the pupal stage. Mating typically occurs in flight when females fly into swarms of males. However, in some species, males will fly to hosts where females are feeding and mate when the females finish feeding. While adults are most abundant near productive breeding sites (‘hot-spots’), they usually disperse to mate and feed. Females fly up to approximately 2km while males usually fly lesser distances (Rutledge, 2005). Despite these short flight distances, much circumstantial evidence exists to suggest that midges can be blown much longer distances (several hundred kms) passively on the wind, especially over water. On land, the distances travelled seem to be significantly shorter.

Adults will mate and females take a blood meal within 24 hours of emerging. Females continue to take blood meals every three to four days until the end of their life (Kitching, 2006). Under optimal conditions of between 13^0C and 30^0C (Kitching, 2006), adults may live between two to seven weeks in laboratory conditions or a few weeks under natural conditions (Rutledge, 2006) but it is probable that their lifespan will rarely exceed 10 days (Kitching, 2006).

The *C. obsoletus* and *C. pulicaris* groups in the UK (which are the most likely vectors in the current outbreaks) probably follow a bivoltine seasonal distribution with two generations/year and with population peaks in May/June and September. *Culicoides* adult activity is determined by temperature so the end of the adult season is determined by the severity of the climate. There is reasonable evidence that they can survive short periods of low temperatures, however, a prolonged period of days and nights with consistently low temperatures will probably cause the deaths of most or all of the adult population. There is some evidence that in recent years very low numbers of adult *Culicoides* have been recorded in each of the winter months (i.e. December, January, February) at IAH, Pirbright, UK (Carpenter, S. – IAH, Pirbright, personal communication, 30 August 2006).

2.3.3 Climatic conditions

When considering a possibility of the BTV being introduced to the UK by competent vectors, two things should be taken into account. Firstly, a possibility that midges are infected with the virus, and secondly, whether such midges may arrive to the UK bearing in mind the ability of vector insects to travel on the wind.

To assess a possibility whether vector insects may arrive to the UK, the meteorological conditions (wind speed and direction) over the infected areas have been investigated by the Met Office, UK, and the Institute for Animal Health, Pirbright, UK. The possibility of local area spread in the currently infected region has been examined together with the risk of longer distance spread to the UK.

Local spread of infection by airborne midges appears very likely, although detailed modelling is required to confirm this.

With regard to assessing the risk of vector insects arriving from the currently affected areas to the UK, a worst case scenario scheme was designed and used for the period 1 July to date (Gloster, 2006). Investigations prior to this time will be completed in the near future. As the number of infected midges is unknown a standard release of model particles has been assumed and as such the modelling results must be treated with caution. The results revealed that:

a) For the vast majority of days in the period studied (1 July to date) the risk was assessed as non-existent (the wind would have blown any airborne midges away from the UK).

b) There were a number of occasions when air from the infected area has blown from the infected area towards the UK; some of these coincided with temperatures in excess of 25^0C in the outbreak area. Adopting a number of comparative risk categories (high to nil) the following exceptions to the nil assessment were found:

- 1, 2 and 3 July 2006 when the assessment gave a medium risk in the area Kent to Newcastle;

- 14 to 25 July 2006 (excluding 19, 20, 22 & 23) and was assessed as low to medium risk in an area from the south coast of England to East Anglia;

- 12 and 16 August there were two assessments of low risk between the south coast and East Anglia and north of the Wash towards Scotland respectively.

Taking into consideration information which indicates that vector midges travel on the wind much more poorly over the land than over water and the length of the land track between the infected area and the UK, the overall risk to the UK has been and remains very low. Only if the outbreaks extend towards the coast and the winds are from the east will the risk rise.

The meteorological conditions are being assessed on a daily basis and the output is being forwarded to Defra on a regular basis allowing ongoing assessment of the risk.

3 Conclusions

The outbreaks of BT in limited areas of the Netherlands, Belgium, Germany and France are a significant development in the epidemiology of the disease in the EU. Although short term developments are likely and new cases may be reported in the currently affected areas, it remains uncertain whether this outbreak will remain localised and confined within the existing restriction zones or will result in further spread into unaffected areas.

It is unlikely that infected competent adult vectors will survive the winter and be able to initiate outbreaks in late spring next year. However, should the BT virus manage to survive either in a vector or a susceptible host over the winter period in certain locations in the affected EU Member States, fresh outbreaks may be expected next year after the population of the adult vectors begin to rise, possibly in the period of May to September.

Tests carried out on cattle and sheep imported from the affected EU Member States to the UK since 1 July have given negative results. Therefore, there is a low likelihood that the disease may have been introduced by movement of domestic cattle or sheep prior to the detection of this outbreak by any consignments from areas now under restriction. However, our understanding of the epidemiology of the disease on the continent continues to develop as new information comes forward. The need for further tracings of imported susceptible animals is therefore subject to review.

In view of the distances involved from a source of infection with BT virus serotype 8 outside Europe the risk of virus introduction via infected vectors is considered to be remote. Similarly, incremental spread from within Europe is also considered to be remote as the serotype detected has never been previously recorded in Europe, the Middle East or North Africa. Although a remote possibility of the introduction of the virus by infected midges being blown to the UK still exists, this is expected to decline further as temperatures decline with the start of the autumn/winter period.

Currently, IAHD does not intend to carry out and publish a full risk assessment on this outbreak but will continue to monitor developments and re-assess the situation as new information become available.

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