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# Seroprevalence of *Schmallenberg virus* in the United Kingdom and the Republic of Ireland: 2011–2013

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ABSTRACT

Since its identification in late 2011, *Schmallenberg virus* (SBV) spread rapidly across Europe. Using archived samples from domestic ruminants collected between October 2011 and June 2013, the seroprevalence in the United Kingdom (UK) and Republic of Ireland (IE) was estimated using a serum neutralisation test. There was no significant difference ($P > 0.05$) in seroprevalence between sheep and cows suggesting that neither species is significantly more at risk of SBV infection in the UK. A single 2011 sample tested positive; the sample was taken in November from a cow in Wiltshire. There was a steady increase in overall seroprevalence during the first three quarters of 2012, which then more than doubled in quarter 4 (October–December), which may reflect a peak of vector activity. By the end of June 2013, overall seroprevalence was around 72%. However, although seroprevalence was over 50% in Wales and southern and central counties of England, it was below 50% in all other areas of the UK and IE. This suggests that there were still substantial numbers of animals at risk of infection in the latter half of 2013.


## 1. Introduction

*Schmallenberg virus* (SBV) is an arbovirus of the Orthobunyavirus genus that is transmitted by biting midges (*Culicoides* spp.). Since its identification at the end of 2011 (Hoffmann et al., 2012), SBV has spread rapidly throughout mainland Europe. SBV infection of adult ruminants appears to be sub-clinical or mild; causing watery diarrhoea, fever and reduced milk production (Muskens et al., 2012). However, infection of animals during pregnancy causes arthrogryposis–hydranencephaly syndrome (AHS), which results in congenital malformations, abortions and stillbirths (Tarlinton et al., 2012).

Although the original identification of SBV infection was made following observation of acute signs in adult dairy cattle from late summer 2011 (Hoffmann et al., 2012), the majority of SBV infections are reported due to the appearance of AHS in calves and lambs. The first cases of AHS were reported in the Netherlands in November and December 2011 and in Belgium in 2012 (Garigliany et al., 2012; van den Brom et al., 2012). By comparison with the related *Akabane virus* (Kirkland et al., 1988), it is suspected that SBV causes AHS only if infection occurs in the mid-stages of pregnancy (Tarlinton et al., 2012). Therefore, it is assumed that when AHS is observed, SBV must have been circulating several months previously. This is supported by the initial detection of SBV in France in January of 2012 on the basis of malformed lambs (Dominguez et al., 2012) with subsequent retrospective analysis identifying seropositive animals sampled in October 2011 (Zanella et al., 2013). Studies of Belgian ruminants found that almost all animals were seropositive for SBV at the end of 2011 (Meroc et al., 2014, 2013a). Although the duration of acquired immunity for SBV remains unknown, it was speculated that herd immunity would prevent a second epidemic in 2012. In a follow-up study, anti-SBV antibody titres remained high in animals one year later and very few clinical cases were reported in 2012 (Meroc et al., 2013b). SBV infection in the United Kingdom (UK) was first identified in malformed lambs from farms in south-eastern coastal regions (Kent, East Sussex, Norfolk and Suffolk) in January 2012 (APHA, 2012; Roberts, 2012).

The aim of this study was to determine the rate and extent of geographical spread of SBV from its first emergence in the UK up to the introduction of an inactivated SBV vaccine by testing archived serum samples from ruminants for SBV-specific antibodies.

## 2. Materials and methods

Archived samples were obtained from the nutritional monitoring analytical services (NUVetNA) located at the School of Veterinary Medicine and Science (University of Nottingham).

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The study was approved by the University of Nottingham's School of Veterinary Medicine and Science Ethics Committee. Sample details (species of origin, location and date of sampling) were obtained from the NUVetNA database. Serum was used for the majority of the testing but where serum was not available, plasma was used.

Virus neutralisation tests (VNT) were carried out as described in Loeffen et al. (2012) using virus strain BH80/11-4 (species *Schmallenberg virus*, genus *Orthobunyavirus*, family *Bunyaviridae*) (kindly provided by M. Beer, Friedrich–Loeffler Institut) with the minor modification that cells were fixed by the addition of 100% ethanol and stained using 0.1% v/v methylene blue in water. Positive and negative controls (samples previously tested with the SBV IDscreen indirect ELISA [IDvet, France] by [BioBest Laboratories, UK]) were tested in parallel with every batch of VNTs.

Seroprevalence maps were generated as choropleth maps in ArcGIS Explorer (Esri, USA). Statistical analysis was performed using a two-tailed Fisher's exact test in GraphPad Prism v6 with the threshold of P set at 0.05.

## 3. Results

Serum samples from 1108 ruminants were retrieved from 34 counties (England: 24; Wales: 3; Northern Ireland: 3; Scotland: 2; Republic of Ireland [IE]: 2). The sampling dates covered the period from October 2011, prior to the first recorded cases of SBV in the UK (APHA, 2012; Sedda and Rogers, 2013), until the end of June 2013. Of the 851 cattle and 251 sheep tested, 396 (46.5%) and 161 (64.1%), respectively, were seropositive.

The samples were grouped by year quarter (Q1 = winter, January–March; Q2 = spring, April–June; Q3 = summer, July–September; and Q4 = autumn, October–December) and analysed for seroprevalence by VNT (Fig. 1A). Of 102 samples taken in 2011, only one, taken from a cow on a farm in South Western England (Wiltshire) during November, tested positive. Antibodies against SBV were found in 14.6% of the animals sampled in the first quarter of 2012 (Q1). Seroprevalence increased steadily in Q2 and Q3 of 2012, but in Q4, a sharp increase (to 74.4%) was recorded. Seroprevalence remained at around this level in Q1 and Q2 of 2013.

To investigate whether sheep or cattle were more at risk of SBV infection, samples were analysed by year and species (Fig. 1B). Seroprevalence for both cattle and sheep increased between 2012 and 2013, but there was no significant difference ($P > 0.05$) in

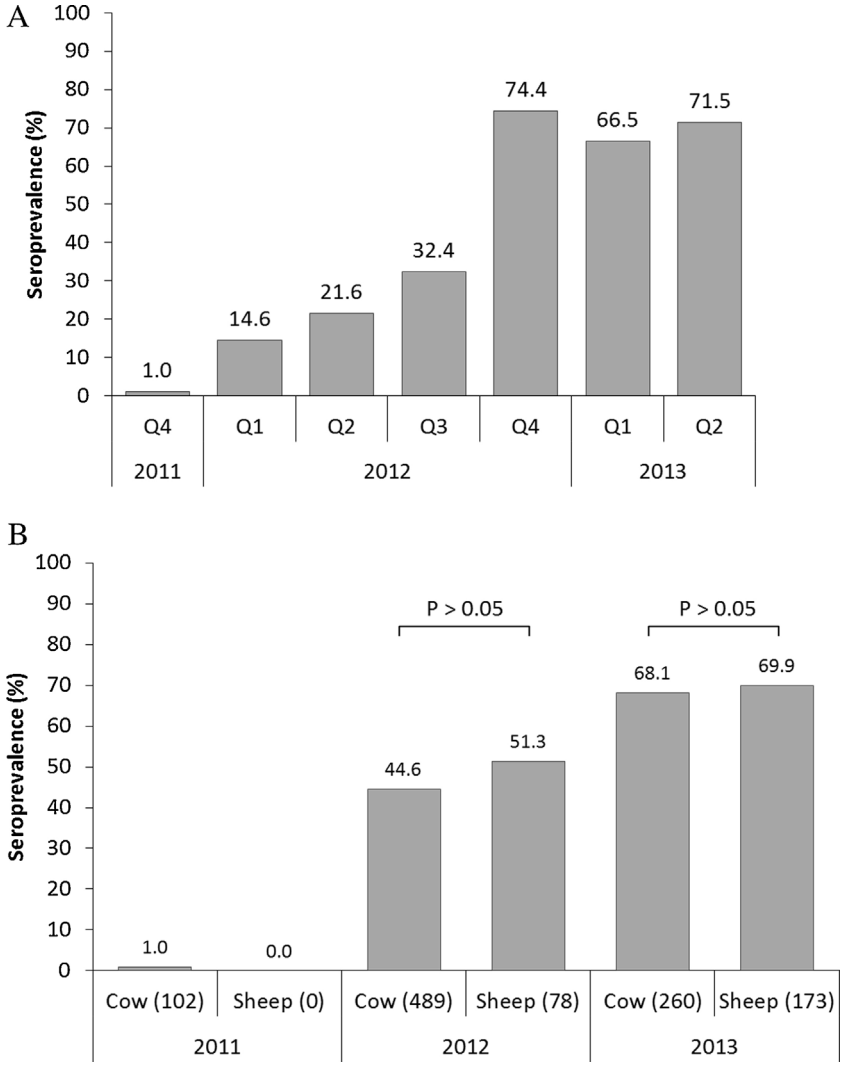


**Fig. 1.** (A) The percentage of serum samples from animals in the United Kingdom and Republic of Ireland that tested positive for *Schmallenberg virus* antibodies in each quarter from October 2011 to June 2013. (B) Seroprevalence of cattle and sheep for October–December 2011, January–December 2012 and January–June 2013 (number of animals tested indicated).