Animal & Plant Health Agency

Epidemiological report on the 2023/24 Bluetongue cases in Kent and Norfolk

From investigations completed from 10 November 2023 to 18 March 2024

July 2024

Any enquiries regarding this publication should be sent to us at

National Emergency Epidemiology Group (NEEG)

www.gov.uk/apha

PB

APHA is an Executive Agency of the Department for Environment, Food and Rural Affairs and also works on behalf of the Scottish Government, Welsh Government and Food Standards Agency to safeguard animal and plant health for the benefit of people, the environment and the economy.

Contents

Summary

a) Bluetongue virus (BTV) serotype 3 (BTV-3) was detected in Great Britain for the first time on 10 November 2024. This was the detection of any bluetongue serotype since the freedom declaration from the 2007-08 BTV-8 outbreak in 2011. The first case was a positive result in Kent (10 November 2023) identified during the 2023 annual BTV survey. This is a risk based targeted surveillance exercise which has been carried out annually in high-risk counties since November 2017 in response to the risk from vector-borne incursions from the near Continent.

b) Another 2 BTV-3 positive cases (animals) were detected on a farm in Norfolk on 8 December 2023 during the same survey. The detection of these cases triggered the declaration of Temporary Control Zones (TCZs), one in Kent and another one in Norfolk on 11 November 2023 and 8 December 2023, respectively. Both zones were extended following epidemiological assessments, and both were lifted on 19 February 2024.

c) The current findings support the working hypothesis that BTV infection was initially introduced, possibly through separate incursions, into the counties of Kent and Norfolk in September 2023 by the windborne dispersal of infected midges from mainland Europe, most likely from the Netherlands.

d) The UK strain of BTV-3 that was isolated from positive animals in both Norfolk and Kent, across all 10 segments of the genome, is 99.9% similar to the Netherlands (2023) BTV-3 strain.

e) Between the initial confirmation of disease and the end of the seasonal low vector period (capture of 5 or more parous midges in any trap in GB) on 18 March 2024, BTV-3 was confirmed by PCR and serological testing in a total of 126 animals: 119 cattle and seven sheep. Given a total of 48,780 samples tested, 22,267 from cattle and 25,795 from sheep, this suggests a 0.53% and 0.03% animal-level prevalence, respectively. The last animal was detected on 8 March 2024.

f) None of these positive animals examined were reported to be clinically affected by their keepers or clinical signs observed during clinical inspection by official veterinarians. Furthermore, no BTV cases were identified from suspect clinical report cases of BTV in the 46 veterinary investigations carried out between 8 November 2023 and 18 March 2024.

g) Up to six individual cases (infected animals) were recorded per epidemiological group, although usually there was only one. Most animals affected were at least 12 months old and female, with 1 transplacental transmission event detected (a positive newly born calf from a positive dam in Kent).

h) The overall between-herd prevalence was 13% overall: 6% in the Kent TCZ and 25% in the Norfolk TCZ.

i) The within-herd prevalence of infection in cattle was 2% overall (2%in Kent and 2% in Norfolk). The within-flock prevalence of infection in sheep was 2% overall (1% in Kent and 3% in Norfolk).

j) The last confirmed case within this period was declared on 8 March 2024.

Introduction

Bluetongue background

Bluetongue virus (BTV) is a non-contagious, vector borne virus of livestock. Bluetongue virus can infect all ruminants (sheep, cattle, deer, goats) as well as camelids (llamas and alpacas) and is the causative agent of bluetongue disease (BT). This can cause severe morbidity and mortality in susceptible ruminants, with sheep typically exhibiting the most severe signs of disease, in particular fine-wool or improved sheep breeds (MacLachlan, 2004). Typically, signs of BT include fever, reduced appetite, lethargy and depression, facial swelling (oedema), reddening of mucosal membranes, oral and nasal lesions, inflammation of the coronary band, lameness and, in severe cases, death (MacLachlan, 2004).

The virus is not zoonotic and there is no public health risk associated with BT, as the virus is not transmitted through contact with animals or wool, or through consumption of milk or meat.

Cattle are typically sub-clinically affected, although may act as ‘reservoir’ hosts of the virus. Due to the impact on trade and animal welfare, BT is listed as a notifiable disease by the World Organisation for Animal Health (WOAH). There are many different serotypes of BTV and many strains within each serotype.

BTV is primarily spread between ruminants by the bites of certain species of Culicoides biting midges (Mellor, 2000). Amongst the smallest blood-feeding insects, the behaviour and abundance of Culicoides is strongly influenced by season and meteorological conditions (Sanders et al., 2011). In order for transmission to occur, BTV must replicate and disseminate from the gut to the salivary glands of a midge. The duration of this process, known as the extrinsic incubation period (EIP), is dependent on ambient temperature. Replication of BTV in Culicoides midges is only possible at temperatures above 11-13 degrees centigrade, depending on the strain (Carpenter et al., 2011).

Due to the influence of temperature on viral replication as well as vector activity and abundance, transmission of BTV is seasonal in temperate regions. The persistence of BTV between years via diverse mechanisms during winter in the Northern Hemisphere is known as overwintering. Several mechanisms that may enable overwintering have been suggested, including the survival of infected Culicoides or maintenance of infection within the ruminant host through prolonged viremia and transplacental transmission (Wilson and Mellor, 2008). Virus could also persist and re-emerge through the use of infected germinal products or the use of attenuated live viruses.

BTV was historically a cause of intermittent outbreaks in southern Europe, potentially associated with windborne incursions from North Africa and Turkey. More recently, the virus has established itself and persisted in southern Europe. Since 2006, the virus has also established and persisted in northern Europe. The transport of infected midges on prevailing winds is thought to facilitate the incursion of BTV into islands, including the UK (Burgin et al., 2013).

Overview of the situation in northern Europe

Prior to 2006, BT appeared to affect only southern Europe, following the introduction of infected livestock or the introduction of infected midges carried by the wind into Spain and Italy (namely Sicily) from North Africa, or into Greece and Bulgaria from Turkey (Wilson and Mellor, 2009).

This changed dramatically when the first case of BTV infection was detected in the Netherlands in August 2006. This was BTV-8, a serotype previously isolated in sub-Saharan Africa which eventually affected over 2,000 holdings in the Netherlands, Belgium, Germany, France, and Luxembourg. The virus successfully overwintered and was detected in the same countries as before the following year, plus in Denmark, Switzerland, the Czech Republic and the UK, affecting over 60,000 holdings by the end of 2007 (Wilson and Mellor, 2009).

BTV-8 was detected near Ipswich (England) on 22 September 2007, despite post-import testing from free areas and a ban on import of susceptible animals from restricted zones in the affected countries in place at the time (Defra, 2007). By mid-March 2008, BTV had been confirmed in 125 premises in 13 counties in the east and southeast of England (Defra, 2008).

The UK regained freedom in 2011, although BTV-8 re-emerged in France in 2015 (Pascall et al., 2020). By 2017 it had affected mainly central France as well as Germany, Switzerland and Belgium. Since 2018, France has declared BTV-4 and BTV-8 to be endemic, therefore the whole country is a BTV restriction zone. On 21 September 2023, there were reports of several clinical cases of BTV-8 in sheep, deemed to be caused by a different strain from the one circulating in 2006-2009 and re-emerging in 2015 (APHA, 2023). Susceptible livestock cannot be imported to Great Britain from France without prior vaccination for BTV-4 and BTV-8.

By June 2023, BTV-8 was present in Spain, France and Switzerland, BTV-4 was present in Portugal, Spain, France and Greece, BTV-16 was present in Greece, BTV-3 was present in Italy, and BTV-1 was also present in Italy and Spain.

On 5 September 2023, the Netherlands detected BTV-3 on a sheep farm. This was the first detection of BTV-3 ever in this country and has since been shown to be a different strain to that found in Italy. By 29 September there had been 416 outbreaks in this country, with BTV-3 being further detected in both Belgium (10 October 2023) and Germany (13 October 2023) (APHA, 2023).

By the end of 2023, BTV-3 had emerged in the Netherlands, Belgium, Germany and the UK (Figure 1) (WOAH, 2024).

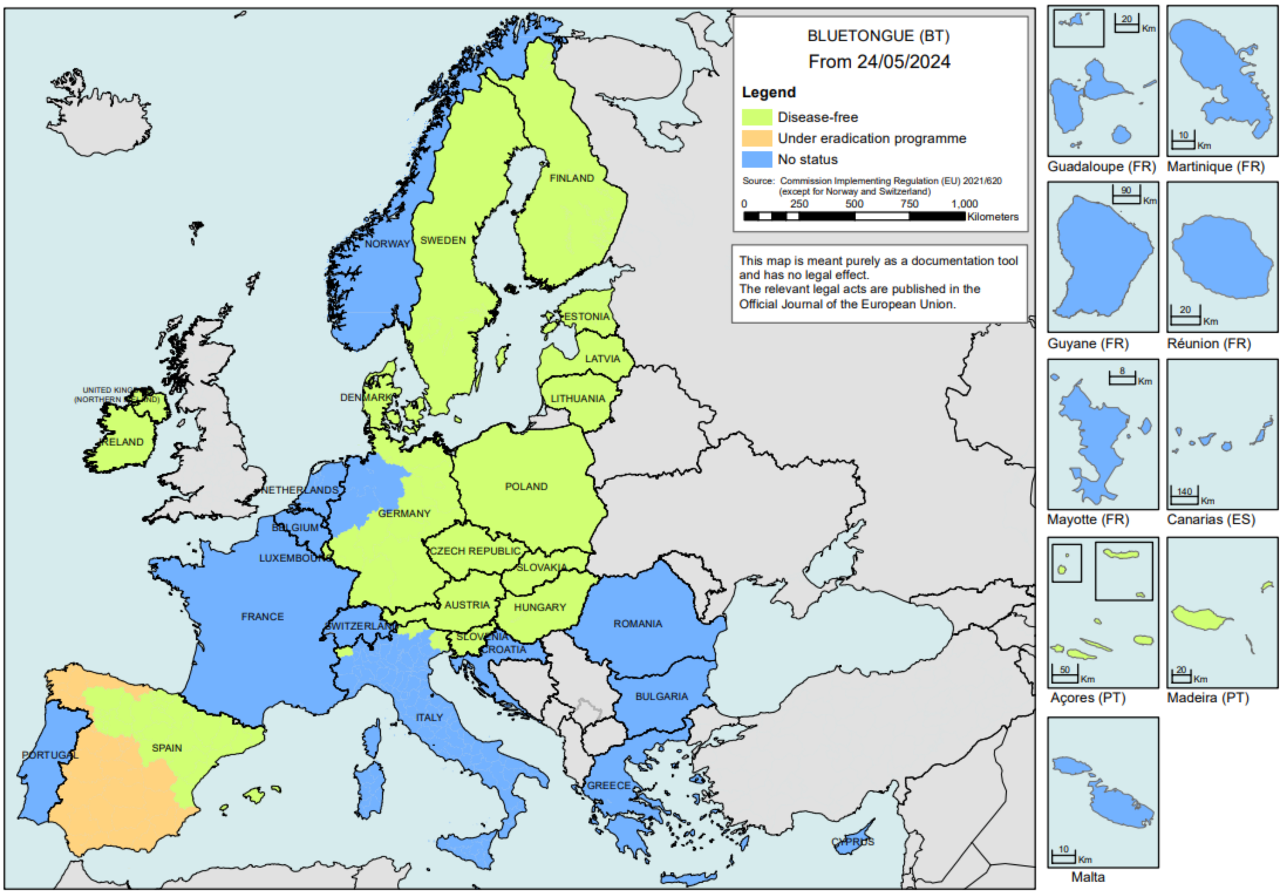

Figure 1. EU Commission map showing EU Member States and zones with disease status ('no status', 'disease-free' or 'under eradication programme') for BT. Parts of northern Europe where BTV has been reported are showing as 'no status', namely France, the Netherlands, Belgium and part of Germany. Available at [Bluetongue - European Commission (europa.eu).]

A ban on trade of live animals from the Netherlands and other BTV affected countries without zoning and eradication plans, and the tracings of imports in the four-week period prior to BTV-3 being confirmed in the UK was in place, with the overall risk of BTV entry into Great Britain being assessed as MEDIUM (meaning it occurs regularly) as of 29 September 2023 (APHA, 2023).

The origin of the recent spread of BTV-3 into northern Europe is unknown, with significant genetic differences identified between this strain and the one circulating in Sardinia and Tunisia as reported by Holwerda (2023, cited in APHA, 2024a). As of mid-March 2024, there have been 5,934 reports of BTV-3 in the Netherlands, seven in Belgium and 50 in Germany (APHA, 2024a) (Table 1).

Table 1. Number of BTV-3 reports in northern Europe between 5 September 2023 and 18 March 2024, and where BTV was confirmed by PCR or clinical signs. Please note NR means ‘not reported’, where we do not have specific numbers for species reported. The highest number of reports came from the Netherlands, affecting sheep (3,165), followed by cattle (2,574) (Nederlandse Voedsel- en Warenautoriteit, 2024).

Country	Diagnostics	Number of reports	Cattle	Sheep	Goat	Alpaca	Llama	Mouflon	Water buffalo	Wisent	Yak	Unspecified
Netherlands	PCR	4,371	NR	NR	0	0	0	0	0	0	0	0
	Clinical	1,563	NR	NR	0	0	0	0	0	0	0	0
	Total	5,934	2,574	3,165	97	39	4	1	1	1	1	51
Germany	PCR	46	45	1	0	0	0	0	0	0	0	0
	Clinical	4	NR	4	0	0	0	0	0	0	0	0
	Total	50	45	5	0	0	0	0	0	0	0	0
Belgium	PCR	2	2	NR	0	0	0	0	0	0	0	0
	Clinical	5	NR	5	0	0	0	0	0	0	0	0
	Total	7	2	5	0	0	0	0	0	0	0	0

UK surveillance strategy

In response to the threat of BT from Europe, the UK carries out passive and enhanced passive surveillance (namely acting on reports of BT suspicion and testing of suspect cases in high-risk counties), horizon scanning, pre-export testing, post-import testing, and regularly monitors the potential risk of incursions of wind-blown insect vectors which may potentially be infected or infectious into the country, via atmospheric dispersion modelling.

In response to the re-emergence and spread of BTV-8 and the threat of incursion that posed, particularly from France, an end-of-season BTV survey has been carried out on an annual basis from 1 November since 2017 (Grace et al., 2020). This is a statutory targeted risk-based surveillance exercise of voluntary participation. The survey aims to provide confidence in the lack of undetected vector-borne incursions of BTV from the near Continent into higher-risk areas in Great Britain during the highest risk period of the BT vector season.

Based on the early warning system for incursions from continental Europe set up in 2007 (Burgin et al., 2013), the potential higher-risk areas for such incursions are determined each year as part of a joint collaboration between APHA, The Pirbright Institute and the Met Office, both on a regular basis throughout the vector active season and towards the end of the season, when end-of-season surveillance plans need to be formulated. The Met Office Numerical Atmospheric-dispersion Modelling Environment (NAME) (Jones et al., 2007), is used to estimate when meteorological conditions are suitable for the transport of any potentially infected midges from the near Continent to Great Britain (Burgin et al., 2013).

The level of risk of airborne incursion from 9 potential sources of interest throughout the near Continent (Figure 2a) is based upon the total number of times plumes from those source areas reach mainland coastal counties in Great Britain. The contours are scaled against the first outbreak of BTV in the UK during September 2007, which shows the clearest indication of a wind-borne incursion from recent outbreaks in Europe (Gloster et al., 2008). The high likelihood contour was scaled to reach the outbreak area on this date, and the medium and lower likelihood contours were each defined as 10-fold orders of magnitude lower (Burgin et al., 2013).

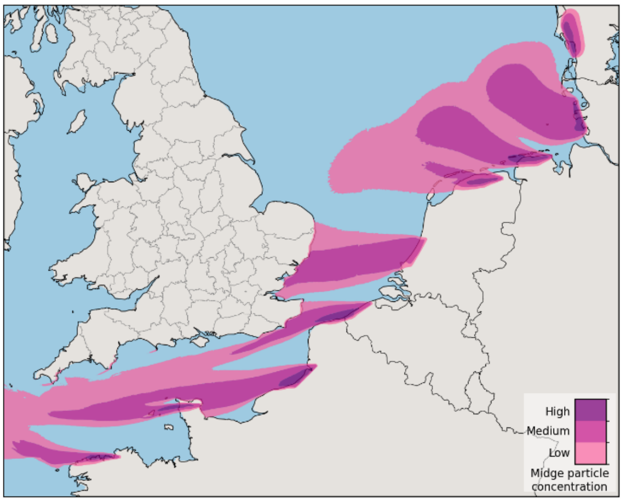

Figure 2a.

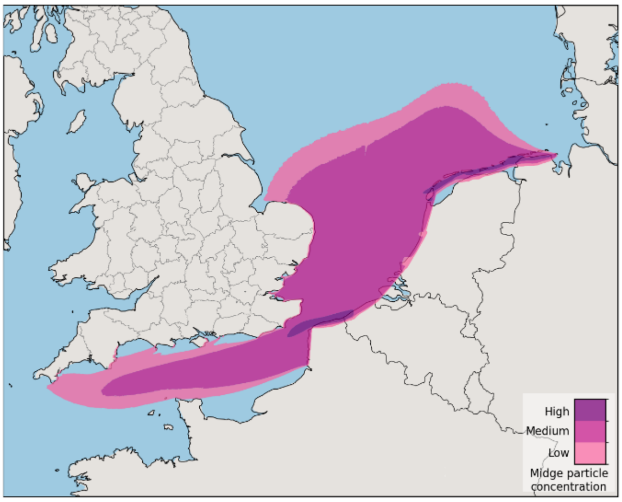

Figure 2b.

Figure 2a and 2b. Examples of midge plume outputs from the NAME dispersion model, showing 9 geographically-spread discrete sources throughout the near Continent (figure 2aleft), and a quasi-continuous source concentrated in northeast France, Belgium, Netherlands and northwest Germany (figure 2b). Plumes from the near Continent are shown touching the south and southeast coast of England, demonstrating that the wind-borne incursion of midges is plausible in suitable meteorological conditions. Courtesy of the Met Office.

As a result of the BT situation in Europe in summer 2023, advice from disease consultants and aggregated outputs from the NAME model, it was suggested that counties along the south and southeast coast of England, from Devon up to Norfolk (both included) should be sampled from 1 November 2023.

The BTV survey follows Commission Implementing Regulation EU No. 456/2012 (assimilated) (European Commission, 2012), with the geographical area of interest (45 km by 45 km) representing an average size county in Great Britain. Using a design prevalence of 5% with a 95% confidence, 6 cattle herds were to be sampled in each county. Larger counties had a larger number of herds sampled, proportionally (Grace et al., 2020).

A single round of PCR testing was carried out as part of the BTV survey, with 15 cattle sampled in each farm. The eligibility criteria applied in 2023 was as follows: between 6 and 96 months of age, homebred or purchased over 6 months ago and grazing during the highest risk vector period. The farms were selected from the pool of farms that were visited as part of other surveillance exercises.

Following confirmation of the first BTV cases in Kent on 10 November 2023 and in Norfolk on 8 December 2023 in 2 farms sampled as part of the BTV survey, Temporary Control Zones (TCZs) were declared. Any outstanding farms selected for the BTV survey that fell within each of the 2 TCZ areas were excluded from the survey, given that all susceptible animals kept in those farms would be sampled as part of TCZ surveillance activities.

The detection of an increasing number of BTV-infected ruminants through the BTV survey and the TCZ surveillance that followed, resulted in an increased number of farmers declining to participate in the survey, as well as dropping out after being enrolled. Due to this, the 14 outstanding farms in Kent, Norfolk and Suffolk as of January 2024, were recruited compulsorily among the population of large coastal cattle herds, given the profile of cases detected to that date. These farms were selected from outside the TCZs, given the reasons stated above. The survey was completed in February 2024, with a total of 1,559 samples collected from 104 holdings (Table 2).

Table 2. Number of farms required, number of farms sampled, and samples collected by county as part of the BTV survey 2023, including PCR results.

County	Number of farms required to be sampled	Number of farms sampled	Number of samples collected	Number of positive samples detected
Devon	18	18	270	0
Dorset	6	6	90	0
East Sussex	6	7	105	0
West Sussex	6	6	90	0
Essex	12	12	179	0
Hampshire & Isle of Wight	10 and 2	10 and 2	150 and 30	0
Kent	12	12	180	3
Norfolk	18	18	270	2
Suffolk	12	13	195	0
Total	**102**	**104**	**1559**	**5**

Out of the 10 counties sampled as part of the BTV survey (Hampshire and the Isle of Wight counted as one geographical unit of interest), positive results were found only in Kent and Norfolk. In addition to the initial cases in Kent and Norfolk mentioned above, 2 more cases were detected on a farm in Kent, during the seasonal vector low period (SVLP).

Initial investigations into the origin of infection and potential spread

The virus detected in the first case was identified as BTV-3, using serotype-specific PCR assays by colleagues at The Pirbright Institute. Full genome sequence analysis of the virus isolated from cases in Kent and Norfolk indicated a 99.9% similarity with the BTV-3 strain detected in the Netherlands in 2023.

Following the confirmation of the first BTV cases in Kent, the Met Office performed additional NAME model simulations. These were focussed on the period August to October, with potential sources of interest concentrated in northeast France, Belgium, the Netherlands and northwest Germany (Figure 2 (b)), to investigate the locations and timings of likely vector incursion events into Great Britain.

Aggregated NAME model outputs suggested that the counties of Norfolk, Suffolk, Essex and Kent had the greatest number of days on which meteorological conditions were suitable for potential airborne vector-borne incursions from sources in the Netherlands throughout August to October (Figure 3). These potential incursions could be clustered roughly into 4 discrete time groups, mid-August, early September, mid-September and mid-October.

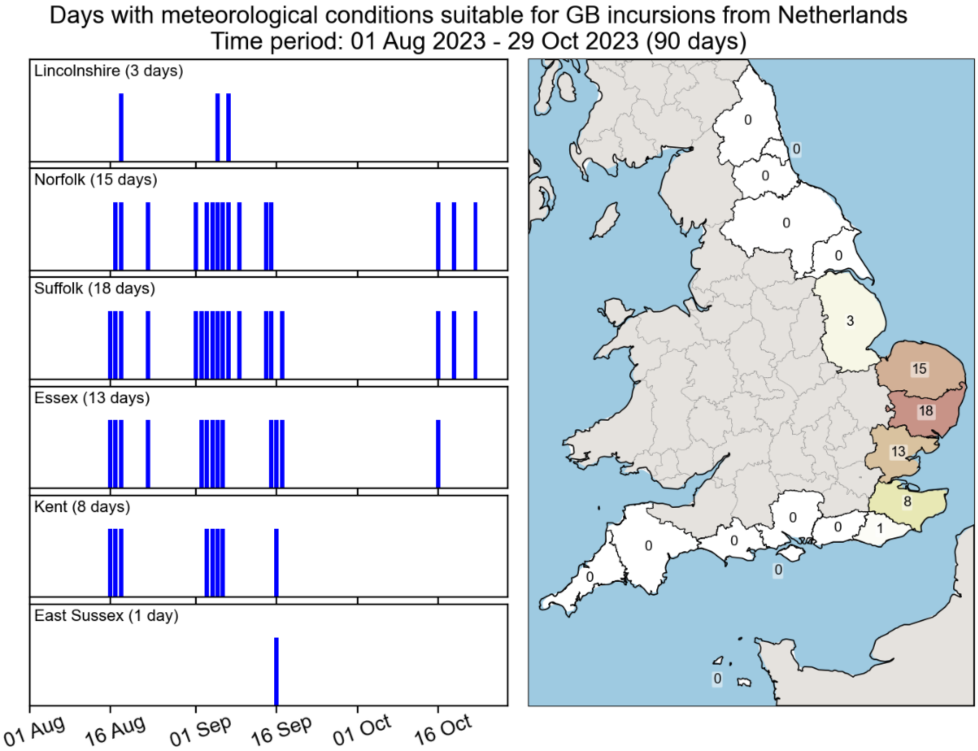

Figure 3. Map showing counties coloured and labelled by the total number days on which meteorological conditions were suitable for windborne incursion of infected vectors from the Netherlands, and timeseries plots for each county indicating the days on which conditions were suitable (blue bars). Courtesy of the Met Office.

Following first confirmation, The Pirbright Institute's BTV transmission model (Sumner et al., 2017) was used to assess potential spread following a windborne incursion of BTV infectious midges into the affected areas. The model used demographic data for 2022, movement data for 2019 and temperature data for 2023.

A single incursion of infected vectors on either 1 August, 16 August, 1 September, 16 September, 1 October, 16 October or 1 November were simulated, with a single farm in either Kent or Norfolk selected at random as the initial site of infection. Simulations were run from the time of incursion to 31 December. One hundred replicates of the model were run for each scenario.

The simulated incursions showed that the earlier the incursion, the larger the subsequent epidemic in terms of both spatial extent (Figure 4) and total number of farms infected over the remainder of the calendar year (Table 2). Furthermore, incursions into Kent tended to result in larger outbreaks than ones in Norfolk.

It is also worth noting that, although an incursion in Kent could result in infected farms in Norfolk (and vice versa) due to the movement of infected livestock, these movements did not typically result in much subsequent local spread, due to temperature constraints and the lower efficiency transmission from livestock to the vector.

Importantly, this work demonstrated that at the time the first cases were detected in Great Britain (from early November onwards), temperatures were likely too low for substantial onward virus spread.

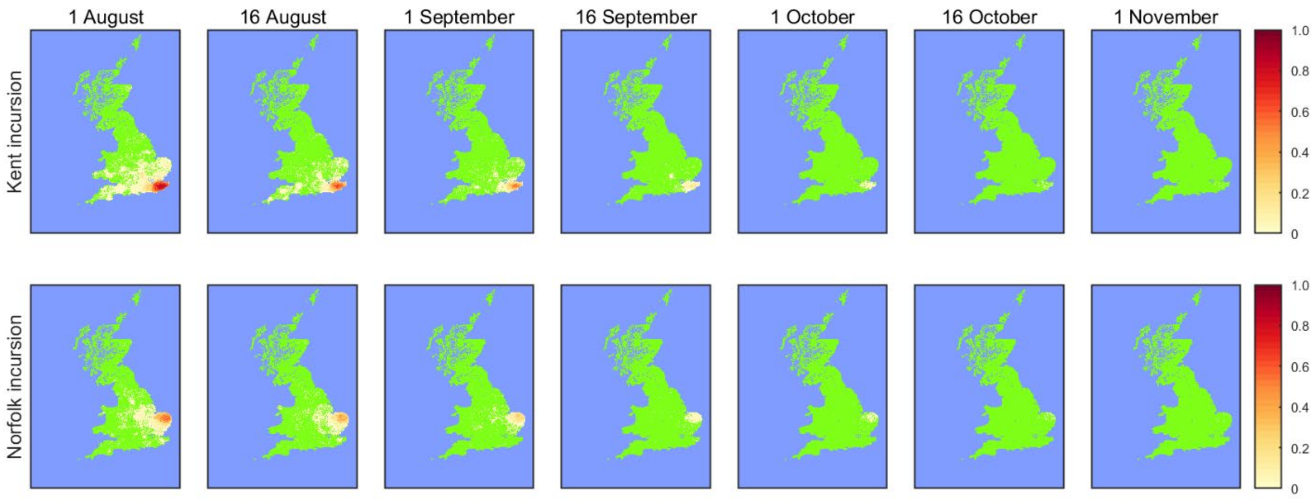

Figure 4. Predicted spatial spread of BTV-3 following vector incursions into Kent (top row) or Norfolk (bottom row), from the date of initial incursion (columns) until 31 December. Each map shows the cumulative risk (see colour bar) expressed as the proportion of simulated epidemics for which at least one farm was infected with BTV within each 5 kilometers by 5 kilometers grid square over the time period in question. Courtesy of The Pirbright Institute.

Table 3. Median and 90% prediction interval for the total number of infected farms in simulated incursions of BTV-3 to Kent or Norfolk.

Time of incursion	Kent			Norfolk		
	median	10th percentile	90th percentile	median	10th percentile	90th percentile
1 August	850	175	2,080	316	59.5	781.5
16 August	320.5	35.5	1,046	150	22	558
1 September	171	24.5	580.5	71.5	14	205
16 September	12.5	1	91	7.5	1.5	37
1 October	2	1	15.5	1	1	7.5
16 October	1	0	1	1	0	1
1 November	0	0	1	0	0	1

Methods of detection

Passive surveillance

Report cases investigations

No reports of clinical suspicion of BT in the UK have been confirmed, on further investigation, in recent years. From 8 November 2023 to 18 March 2024, 46 cases were investigated and negated (Figure 5). The first report case investigated since the confirmation of the first case in Kent was reported on 10 November 2023 (the 19th report case in 2023) and the last one on 18 March 2024.

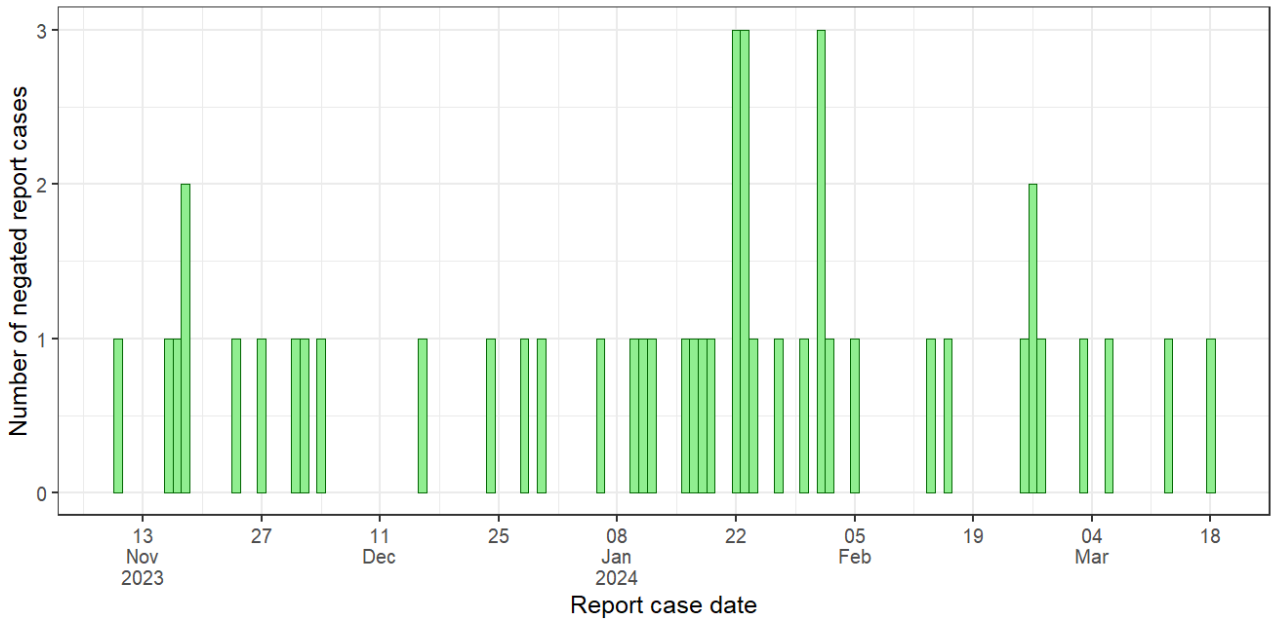

Figure 5. Number of daily BTV report cases within Great Britain between 8 November

2023 and 18 March 2024, with the highest number reported per day as 3. All reports were subsequently negated.

The majority of these negated report cases were suspected in sheep (32), followed by cattle (13) and goats (1). Nearly as many were reported in Wales (20) as in England (25), with only one being reported in Scotland (Figure 6). The majority of them (8) originated from Carmarthenshire (Wales), followed by Norfolk (England). Seventeen of these negated report cases were raised following suspicion from pathology investigations at Veterinary Investigation Centres.

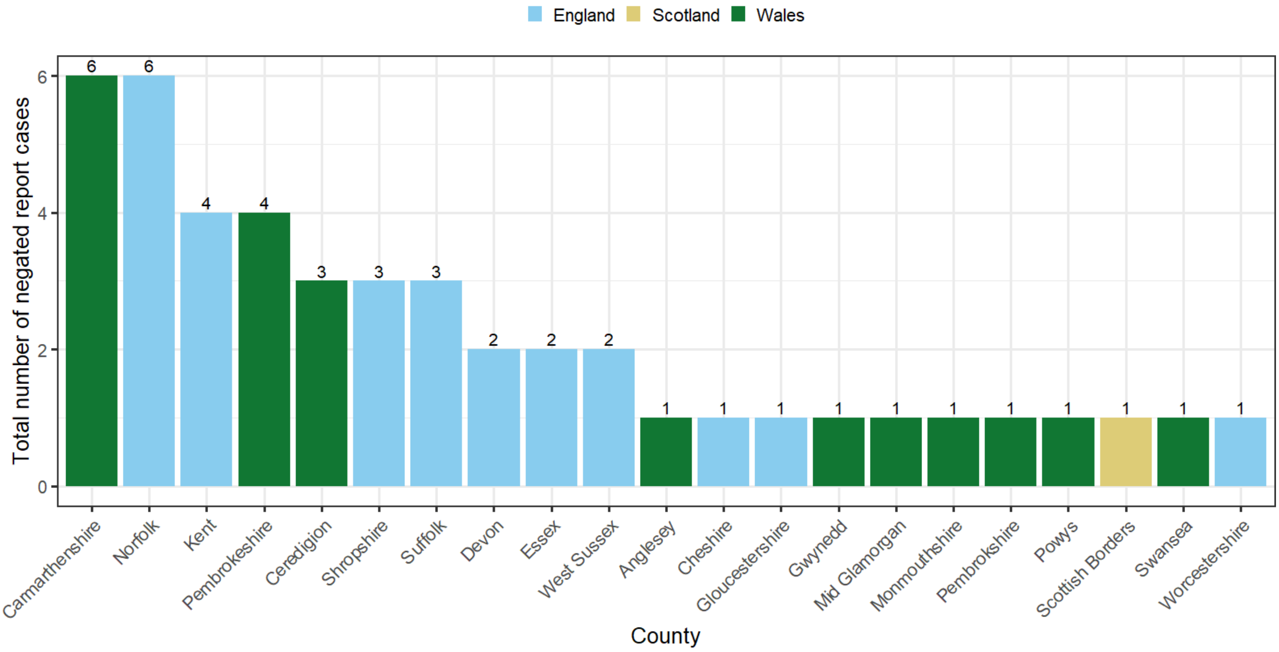

Figure 6. Number of negated report cases from 8 November 2023 until 18 March 2024 by disclosing county and country. The highest number of negated report cases were located in Carmarthenshire (Wales) and Norfolk (England), both with 6.

Active surveillance

TCZ surveillance

Following the confirmation of the first case in Kent on 10 November 2023, a 10 km TCZ was declared on 11 November 2023 in the Canterbury area of that county (Figure 7). The aim was to contain the disease while at the same time to carry out surveillance visits with sampling of susceptible animals to establish whether there was evidence of circulating disease in the midge population and to identify any more cases. Any positive animals detected before the declaration of the SVLP were culled to reduce the possibility of spread and overwintering in UK.

The cases detected through TCZ surveillance in farms in Kent revealed the potential presence of infection in the Sandwich Bay area, given some positive cattle had been grazing there until shortly before the sampling date. This triggered the extension of the original TCZ to cover the whole of the northeast corner of Kent on 4 December 2023 (Figure 7).

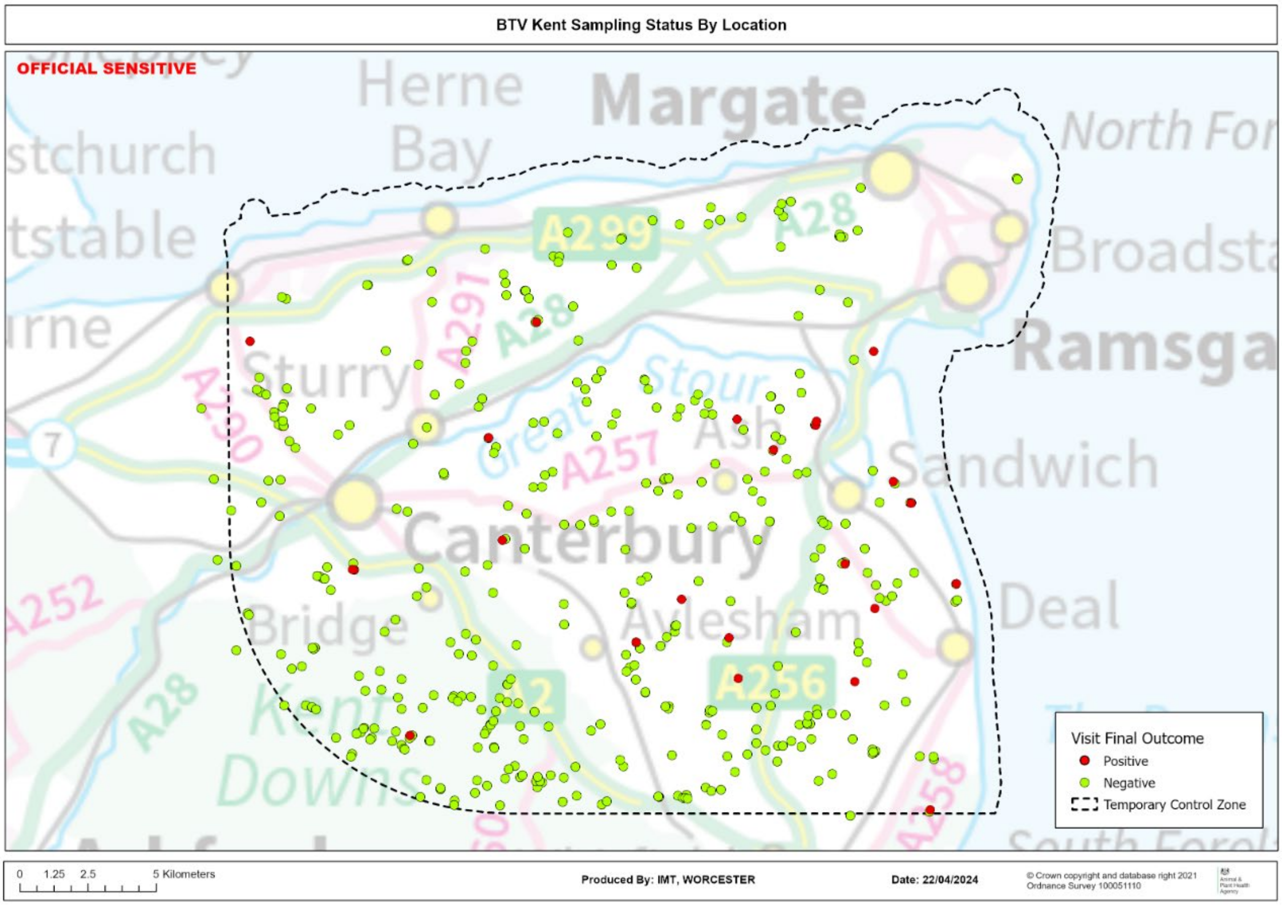

Figure 7. Map showing the location of cases detected by TCZ surveillance visits in Kent with the former extended TCZ overlaid. Positive results were detected all over the TCZ.

Similarly, the detection of 2 new bovine cases on a farm in Norfolk through the BTV survey triggered the declaration of a second TCZ in the Cantley area of that county on 8 December 2023 (Figure 8). This was also slightly extended on 27 January 2024 to account for a grazing area that had been accessed by subsequent cases detected via TCZ surveillance.

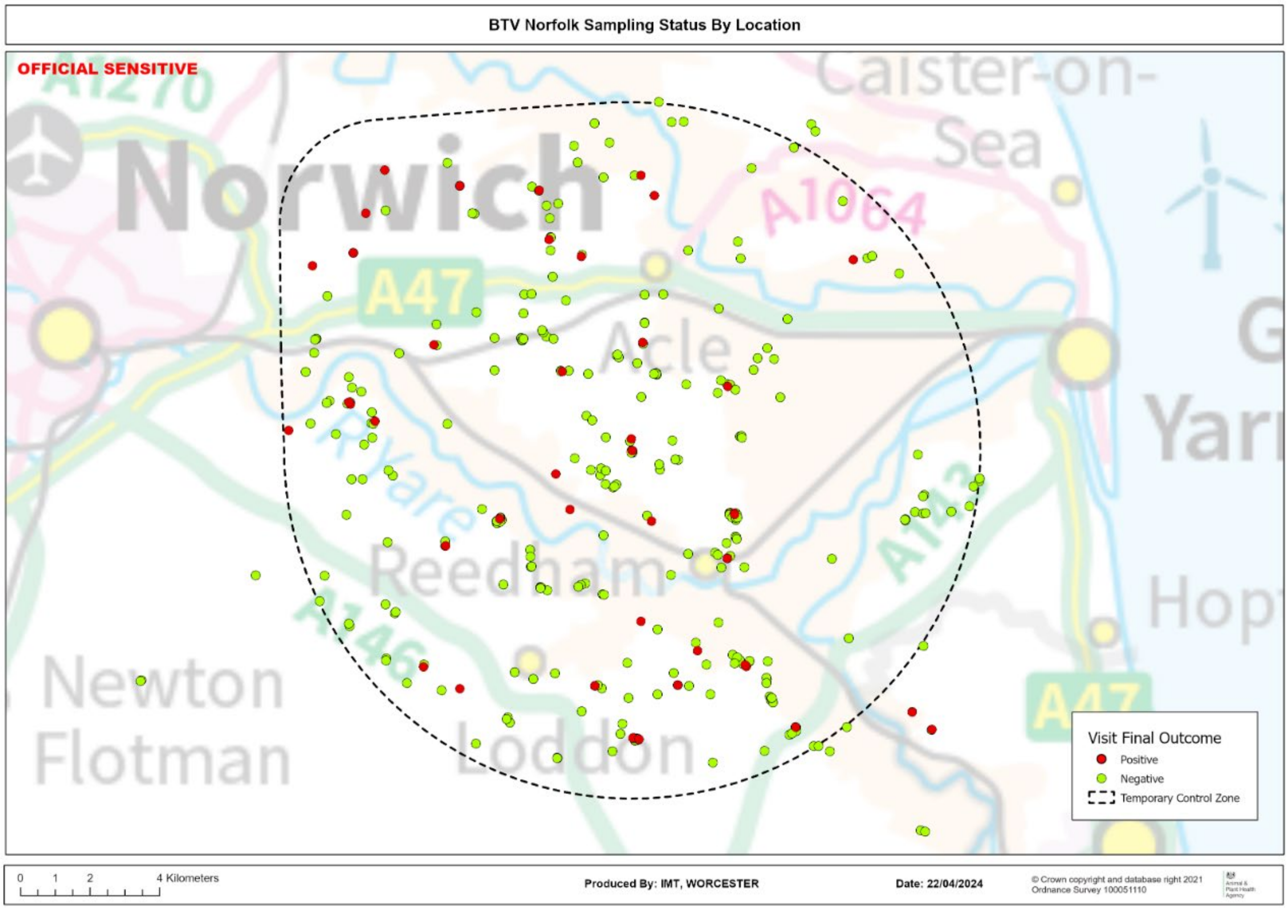

Figure 8. Map showing the location of cases detected by TCZ surveillance visits in Norfolk with former extended TCZ overlaid. Positive results were detected all over the TCZ.

The TCZs were located in areas of medium density for cattle (with higher density areas in Norfolk TCZ) and low density for sheep and goats (Annex A).

A small number of positive cases (10 animals) in premises outside the zone had epidemiological links to premises with positive animals within the zone. All remaining animals on these premises were tested with negative results and, given the time of year and the nature of the epidemiological links, the TCZ was not extended.

There were 5 holdings that refused to be sampled (livestock considered pets by owners) that remain under restrictions. In addition to these, 5 zoos and wildlife parks within TCZs had only a clinical inspection visit due to handling and welfare issues (some susceptible animals were endangered species).

A total of 802 TCZ surveillance visits to 415 holdings (some holdings tested over a number of days) were carried out as part of TCZ surveillance activities, with 112 cases detected by these (Table 4): 40 in Kent, 66 in Norfolk (including 1 holding in Suffolk with grazing in the Norfolk TCZ) and 6 in Suffolk. A further 9 cases on 8 premises were identified as a result of tracing activities from premises with positive animals (1 in Kent, 4 in Norfolk, 3 in Suffolk, and 1 in Surrey), see below. Perceived gaps in spatial coverage in Figures 7 and

8, with no farms sampled, are due to the presence of marshland and a lack of farms registered in those areas.

Table 4. Overview of TCZ surveillance and tracings activities (see section further below), with numbers of cases detected inside and outside these zones. Within the surveillance TCZ visits, the ones in the 'No zone' category refer to premises linked to the zones but with a holding georeferenced outside.

Zone	Total TCZ visits	Total Tracing visits	Total cases (cattle, sheep)
Canterbury (Kent)	480	6	44 (40 bovine, 4 ovine)
Cantley (Norfolk)	244	4	72 (69 bovine, 3 ovine)
No zone	78	93	10 (10 bovine)
Total	**802**	**103**	**126**

A timeline of events following the detection of incursions of BTV-3 in November 2023 is provided below (Figure 9).

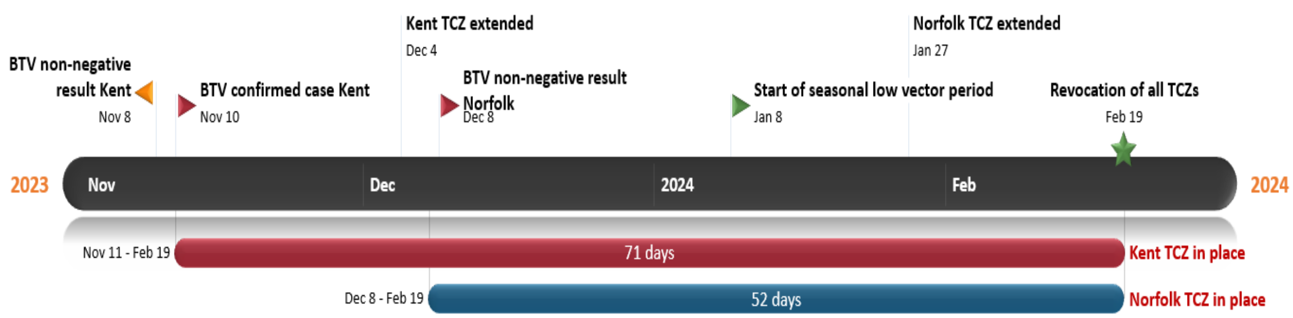

Figure 9. Timeline of events following BTV-3 incursions in Kent and Norfolk, including detection of first cases in the zones, TCZs start and end dates, and start of Seasonal Low Vector Period. The TCZ in Kent had a duration of 71 days, whereas the one in Norfolk had a duration of 52 days.

Movements out of the TCZs

The start of the precautionary tracing window was set as 1 September 2023, a few days before the first BTV-3 case in the Netherlands was declared to WOAH on 5 September 2023. Movements of cattle, sheep and goats during the tracing window from negative premises located within both TCZs were also investigated.

Fifty-one cattle and 130 sheep were moved to a total of 16 premises located 150km or more away from the TCZs, in the counties of Cumbria, Devon, Leicestershire, Somerset, Lancashire, West Yorkshire, North Yorkshire and Fife (Figure 10).

Figure 10. Map showing the location of the farms beyond 150 km from the TCZ areas (denoted by a continuous black line) traced following animal movements out of the TCZs (denoted by discontinuous black lines) from non-affected premises. Farms were traced as far as Scotland in the north and Exeter in the south-west.

Where traced animals were still alive at the destination premises, these were sampled. A total of 44 cattle on six premises and 33 sheep on 3 premises were tested, all returning negative results. The animals sampled were located in Cumbria, Devon, Leicestershire and Fife.

A similar tracing exercise for movements 100-150km away from the TCZs and from the TCZs to 100km away had also been initially considered. A decision not to follow these up was subsequently made due to relatively small numbers of movements and the fact that, by then, Great Britain had entered the SVLP.

Tracings

Data on susceptible animals leaving any positive premises within the tracing window (as above) was collected during field investigation visits. The premises where any traced animals were found were put under restrictions until a negative test result was received for them.

On a number of traced premises, some or all of the traced animals had already been sent to slaughter or to other premises, and thus were not available for sampling to establish their disease status. These premises were described as "intermediate premises". In order to formulate an exit strategy for these premises, without the need to sample all susceptible species present to provide reassurance of their disease status, the APHA Field Epidemiology team developed a rapid risk assessment tool.

This considered relevant epidemiological information from the originating premises as well as the average daily temperature data at the destination premises for the period from the arrival of the traced animals to the start of the SVLP. The methodology for the risk assessment tool was agreed with The Pirbright Institute and policy teams.

The tool was designed to assess the likelihood of any traced animals being viraemic at the time of the movement and then of being bitten by Culicoides vectors at the destination premises. Whether those vectors could have completed an EIP and potentially become competent to transmit virus to other susceptible species was also considered.

A total of 35 traced premises were so assessed. For 32 of them the outcome of the risk assessment was low risk and recommendations were made to lift the whole premises tracing restrictions. Three premises were identified as being medium to high risk and sampling of all susceptible species was recommended. As a result, an additional 4 positive animals (all of which were cattle) were detected on the 3 premises.

The tool was also subsequently used to assess the risk of onward transmission of BTV on premises where the traced animals had been sampled and had given positive results.

A total of 103 tracing visits were carried out (Table 3), resulting in 9 cases detected (1 in Kent, 4 in Norfolk, 3 in Suffolk, and 1 in Surrey) in 8eigh premises. The majority of premises investigated as part of tracing activities were located outside the TCZs declared (Figure 11). Any cases identified within these premises did not trigger new TCZs since they were detected during the SVLP.

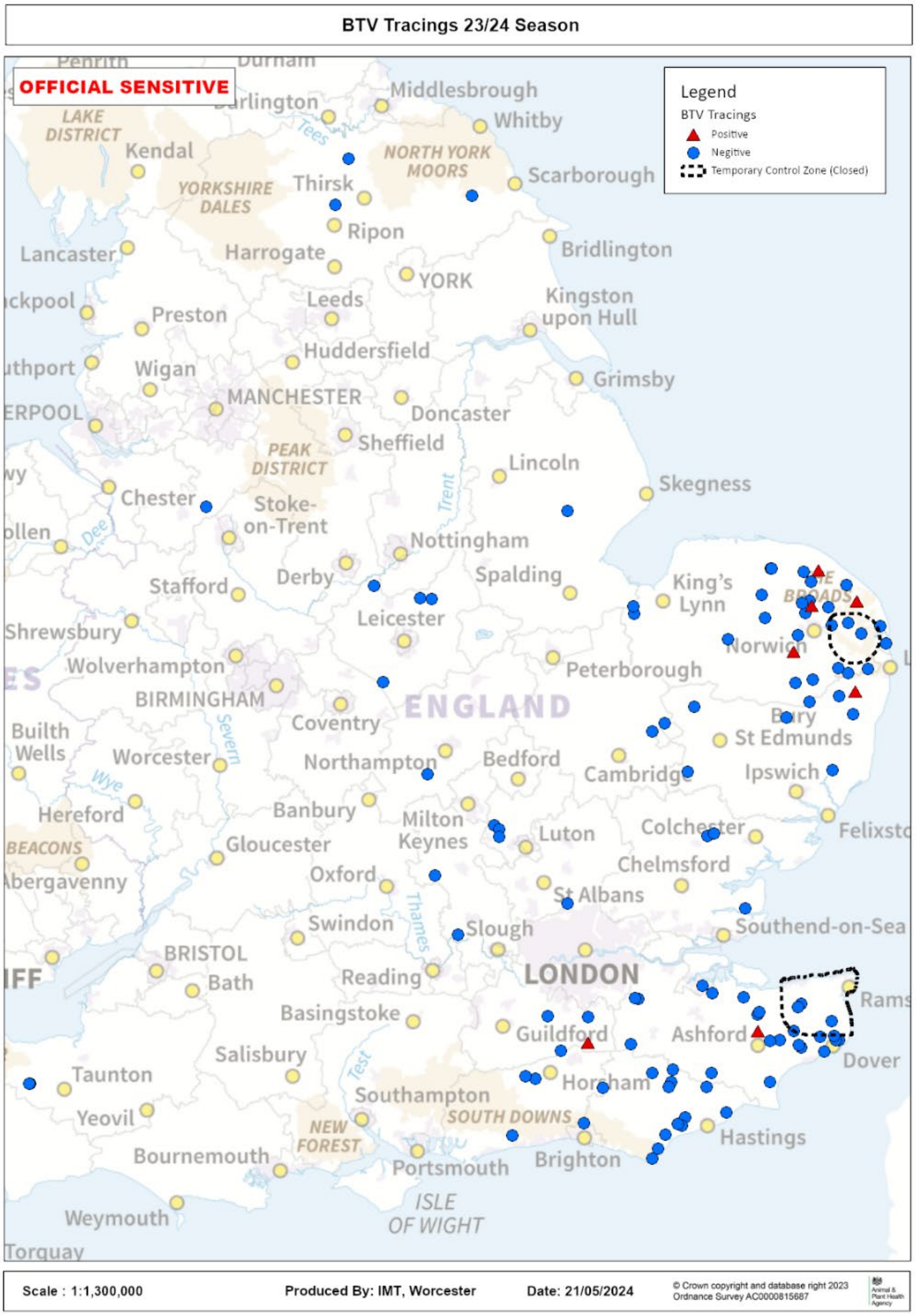

Figure 11. Map showing the location of premises investigated as part of BTV tracing activities from positive premises, their test results and the former TCZs overlaid. The traced premises that resulted in additional cases are located outside the former TCZs, shown with red triangles.

Post-import testing

From the 10 November 2023 until the 18 March 2024, a total 1,273 cattle in 37 consignments imported from Czechia, Denmark and Luxembourg were subject to post-import testing. The majority of consignments originated from Denmark (28 consignments, totalling 1,005 cattle). All tested negative for BTV by PCR testing.

Movement controls

TCZ restrictions limited the livestock movements permitted in these areas to try to contain the spread of BTV via undisclosed infected livestock. Within a TCZ, no person could move any animal onto or off premises in the zone except in accordance with a licence issued by a veterinary inspector.

Specific licences could be issued subject to a satisfactory risk assessment to support farmers affected by restrictions, allowing them to move livestock:

- from a BTV restricted holding to a designated slaughterhouse: 19 slaughterhouses were designated as of the end of April 2024 (APHA, 2024b)
- from an unrestricted holding (including from a market) to a BTV restricted one
- between BTV restricted holdings
- out of a BTV restricted holding due to urgent welfare concerns, although this was subject to a maximum distance of 10 miles, post-movement testing and restrictions on the destination premises

As of the 22 March 2024, 654 licences had been requested, out of which 463 or 71% were approved (104 or 16% were withdrawn). The majority of the licences issued were to send animals to slaughter (353 or 54%), followed by welfare reasons (137 or 21%).

Epidemiological findings

Entomological surveillance

The UK Culicoides Reference Laboratory at The Pirbright Institute has been conducting surveillance of Culicoides biting midges since 2006. In response to the incursion of BTV into the UK in 2023, additional trapping sites were set up in Kent, both at the index farm and at another livestock holding nearby, and in Norfolk. There are currently 18 traps in the surveillance network (Figure 12).

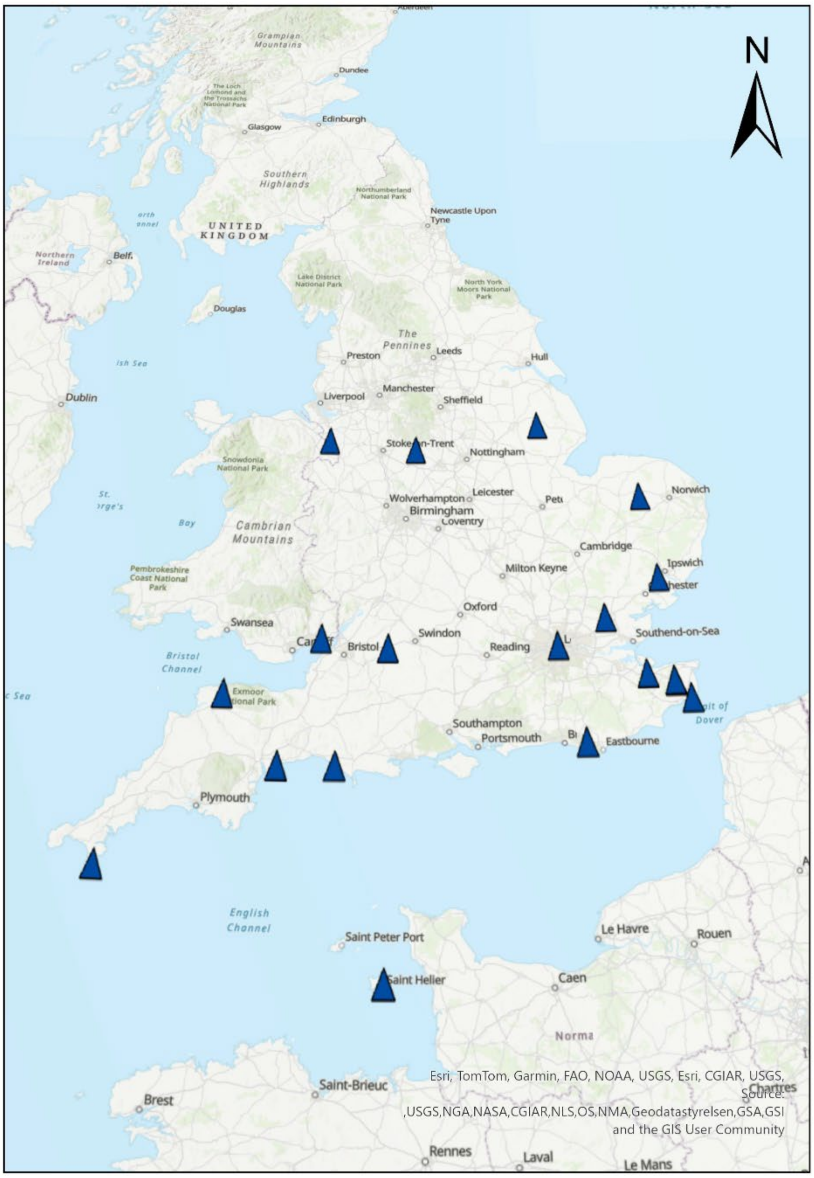

Figure 12. Locations of Culicoides collection traps across the UK indicated by blue triangles. The most northern traps are located in the midlands. Courtesy of The Pirbright Institute.

Culicoides are collected using Onderstepoort Veterinary Institute (OVI) UV light suction traps which are run overnight from dusk until dawn for 1 night each week. Collections are made by volunteer livestock keepers, stored in 70% ethanol and sent to The Pirbright Institute for subsequent identification.

Culicoides found in collections are identified to species level, and age graded according to the pigmentation of their abdomens. The seasonal vector low period (SVLP) occurs when all sites in the surveillance network collect less than 5 pigmented/parous female vectors consistently over 2 weeks. The SVLP began on 8 January 2024. The SVLP ends when five or more pigmented female vectors are collected at any collection site and in 2024. This year, the SVLP ended on 18 March.

Bluetongue cases 2023/24

The first BTV-3 case was disclosed on 8 November 2023 in a farm near Canterbury (Kent) and confirmed on 10 November 2023. As of 18 March, 126 cases had been confirmed, the last one on 8 March 2024. These cases were detected due to sampling activities, with clinical signs of BTV absent at the time of the visit, meaning there were historical infections. Forty-four cases were detected in Kent, 72 in Norfolk (including 1 case with a Suffolk holding number but grazing land in Norfolk), 9 in Suffolk and 1 in Surrey during this period (Figure 13).

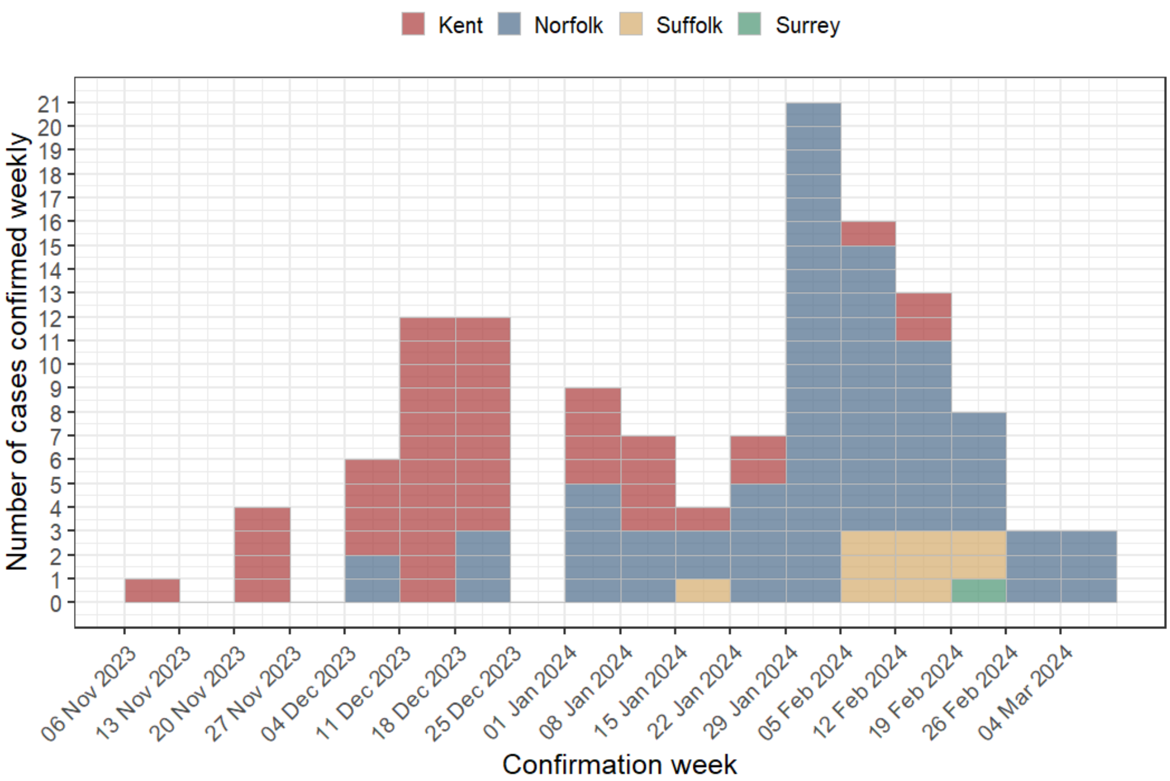

Figure 13. Total number of historical BTV cases confirmed daily from 10 November 2023 until 8 March 2024 by county. The majority of cases were detected in Norfolk.

Following the declaration of the SVLP on 28 January (backdated to 8 January), the policy to cull any positive animals ceased. Cases detected in areas and counties outside the existing TCZs did not trigger new restricted zones due to various reasons: being due to tracings with no further spread, susceptible animals having grazed inside a TCZ, and cases being detected during the SVLP.

As mentioned before, the majority of cases (117 or 93%) were detected through the BTV annual surveillance programme (5 or 4%) or TCZ surveillance (112 or 89%) (Figure 14), triggered as a result of the detection of the initial cases in Kent and Norfolk via the BTV survey. The last 2 cases detected in a farm in Kent via the BTV survey were so during the SVLP, not triggering an extension to the TCZ. Tracing activities disclosed nine (7%) further cases.

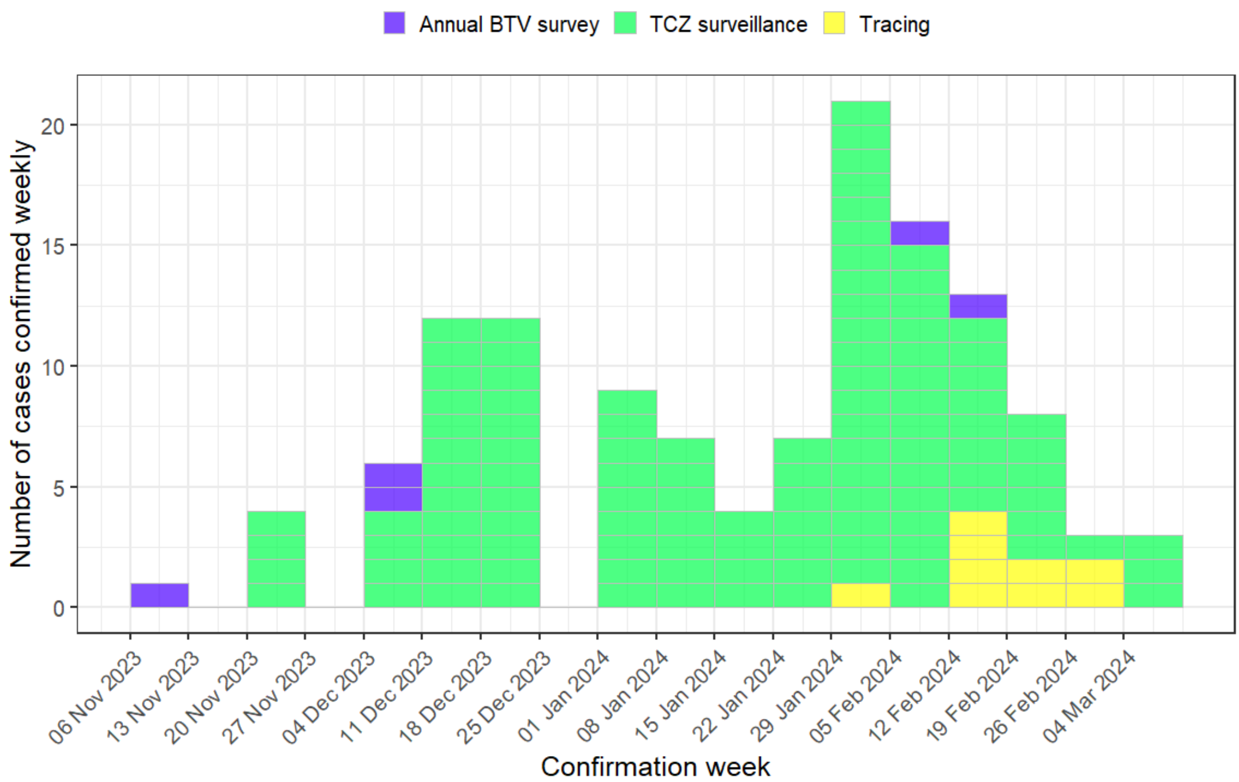

Figure 14. Historical BTV cases by detection method and week of confirmation in all counties. The majority of BTV cases were detected via TCZ surveillance.

Nearly three quarters of positive cases (92 out of 126) had moved from another location between the start of the tracing window on 1 September 2023 and the declaration of the TCZs (Figure 9). For 17 cases this information was not available. These movements were typically from abundant summer grazing in marshland to overwintering accommodation. This is a routine annual practice in the affected counties. Typically, the summer grazing is more coastal and hence in more likely sites for a windborne incursion of infectious midges to arrive into the UK. Some farmers required movement licences to move their livestock back to their winter housing premises, including for BTV testing.

The majority of cases in individual animals, 116 out of 126 or 92%, were detected in adults (12 months or over), whereas 10 out of 126 or 8% of cases were under 12 months of age

(9 calves and one lamb) (Figure 16). Three-quarters of the cases (94) were detected in females and a quarter (24) in males (the sex was not specified in 2 cases). Ninety-two percent of cases (116 out of 126) were in cattle kept for the production of meat and 2% (3 cases) were in cattle kept for dairy production purposes (Figure 15).

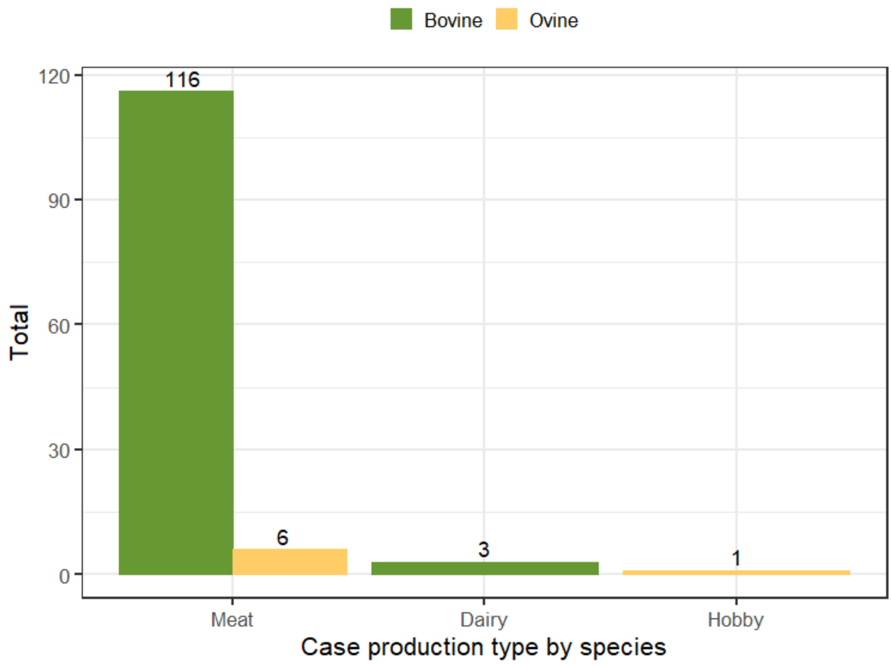

Figure 15. Number of positive cases by species and holding production type. The majority of holdings with positive cases were in beef cattle.

Out of the 126 positive results, 119 or 94% were detected in cattle and 7 or 6% in sheep (Table 5). The animal-level prevalence was nearly 18 times higher in cattle (0.53%) compared to sheep (0.03%), even when 16% more sheep were sampled (3,528 more samples). The BTV cases detected in each holding belong to a single species in all holdings, except in 1 farm in Norfolk were 3 cattle and 1 sheep tested positive.

Table 5. Total number of samples taken for BTV-3 testing by species, number of positive results, and overall animal level prevalence as a percentage.

Species	Samples tested	Total positive	Overall animal-level prevalence (%)
Sheep	25,795	7	0.03
Cattle	22,267	119	0.53
Goats	569	0	0.00
Other	149	0	0.00
Total	**48,780**	**126**	**0.26**

The majority of affected holdings had only cattle, followed by cattle and sheep (Figure 16).

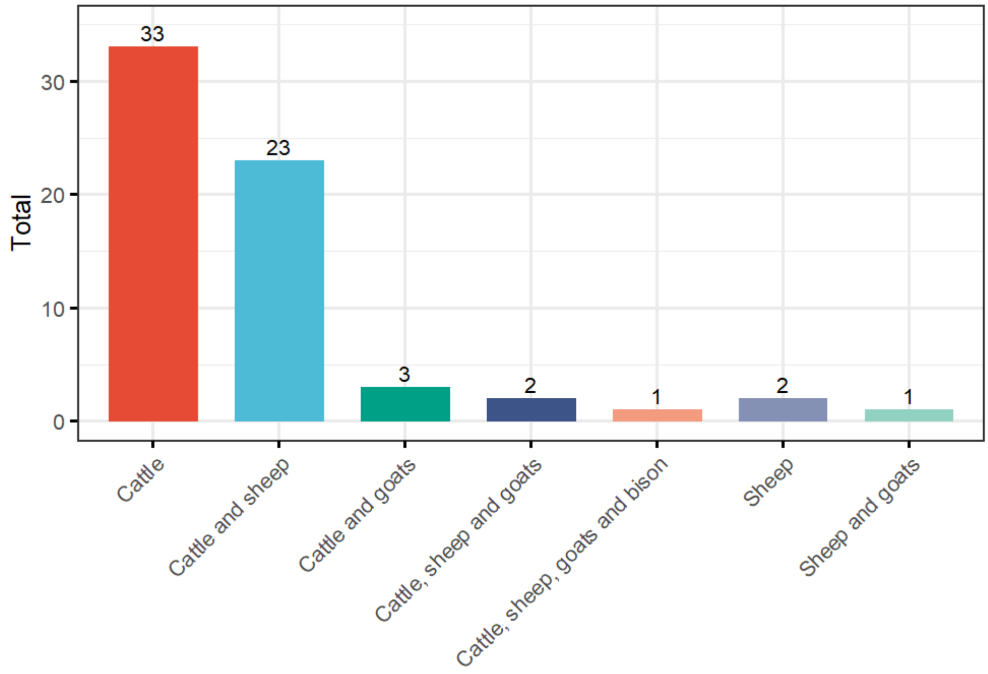

Figure 16. Number of holdings that had positive cases by species kept in the holding. The majority of affected holdings had only cattle.

The average number of animals per affected holding was 642 animals, 516 was the average herd size for affected holdings with cattle and 729 was the mean flock size for affected holdings with sheep.

Positive BTV cases were detected in 66 epidemiological groups within 65 holdings (one holding in Suffolk with grazing in the Norfolk TCZ was assigned to Norfolk, as previously mentioned). Epi groups are groups of animals with the same likelihood of exposure to the disease; in this context, a premise has been considered an epi group. In the majority of epi groups (40 out of 66 or 61%) there was only one case confirmed (Figure 17).

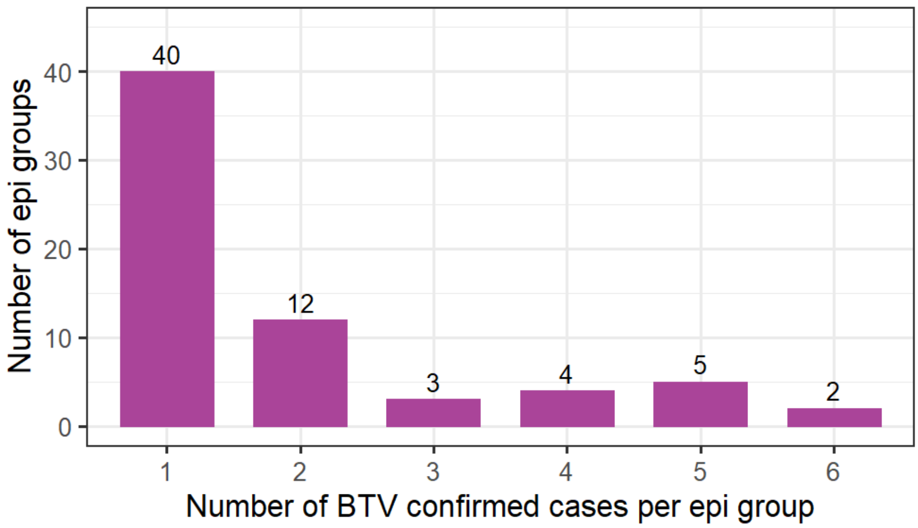

Figure 17. Number of confirmed BTV cases per epidemiological group. In the majority of epidemiological groups there was 1 confirmed case only.

Fifty-six affected epidemiological groups (in 54 holdings) were disclosed by TCZ surveillance, whereas 363 premises were tested negative, giving a between-herd prevalence in the TCZ areas of 13%. The between-herd prevalences by area were 6% in Kent and 25% in Norfolk.

The mean prevalence within epidemiological groups was 2% overall (minimum of 0.1% and maximum of 9%), as well as in Kent (minimum of 0.1% and maximum of 6%) and in Norfolk (minimum of 0.1% and maximum of 9%)

Sheep cases

The 7 sheep cases were identified by TCZ surveillance: 4 in Kent and 3 in Norfolk. These were detected in 7 epidemiological groups, with a single case detected in each of them. The ages of the confirmed cases in sheep ranged from 10 to 36 months. Six of the 7 sheep cases were adult animals (namely 12 months old or older). Three adult ovine cases were detected in each TCZ and the lamb was detected in Kent. Three of the confirmed cases in sheep were female, 2 were male and in 2 instances the sex was not recorded.

The flock size of the epidemiological groups where the sheep cases were detected ranged from 14 to 206 sheep (mean of 95 and median of 88). The average flock size per epidemiological group was 119 in Kent and 64 in Norfolk (median of 112 and 88, respectively). The mean within-flock prevalence was 2% overall (minimum of 0.5% and maximum of 6%), 1% in Kent (minimum of 0.5% and maximum of 2%) and 3% in Norfolk (minimum of 1% and maximum of 6%).

Cattle cases

Out of the 119 cattle cases, 105 were identified by TCZ surveillance, 9 by tracings and 5 via the BTV survey. Forty epidemiological groups were located in Kent, 67 in Norfolk, 11 in Suffolk, and 1 in Surrey. Up to 6 bovine cases were identified in each of them, although in the majority of cases (35 or 58%) there was only 1 bovine positive in each epidemiological group (Table 6).

Table 6. Number of confirmed BTV cases per epidemiological group, number and percentage of epidemiological groups by number of bovine cases. In the majority of bovine epidemiological groups, there was 1 cattle case per epidemiological group only.

Number of bovine cases per epidemiological group	Number of epidemiological groups	Percentage
1	35	58%
2	11	18%
3	3	5%
4	4	7%
5	5	8%
6	2	3%

The ages of the cattle cases ranged from 0 to 248 months old. Only 9 cases were in animals under 12 months of age. One cattle case was in a newly born calf, born to a positive dam in a farm in Kent, providing evidence of BTV-3 transplacental transmission. Just over three quarters of the cases were female (91 out of 119).

The herd size of epidemiological groups where cattle cases were confirmed ranged from 4 to 3,737 animals (average of 453 and median of 165). The average epidemiological group size was 266 in Kent, 584 in Norfolk, 255 in Suffolk, and 690 in Surrey. The mean within-herd prevalence was 2% overall (minimum of 0.1% and maximum of 9%), as well as in Kent (minimum of 0.1% and maximum of 6%) and in Norfolk (minimum of 0.1% and maximum of 9%), 1% in Suffolk (minimum of 1% and maximum of 2%) and 0.1% in Surrey.

Likely incursion dates

Looking at the 4 potential incursion risk periods from the Netherlands identified by atmospheric dispersion modelling (mid-August, early September, mid-September and mid-October), the observed cases compared with the model simulation results provide less support for incursions in mid-October (which would have been expected to result in fewer cases than those observed) (Table 3).

Additional work conducted in the Netherlands has suggested that the first reported cases in early September were promptly identified (Holwerda et al., 2023), which would make incursions in August less likely.

Therefore, assuming that the parameters used in the model, largely based on the BTV-8 in Great Britain in 2007, are also appropriate for BTV-3 (which is currently considered to be the case), it is most likely that incursions into Kent and Norfolk occurred through separate incursion events in early to mid-September.

Conclusions and uncertainties

The detection of BTV-3 in Great Britain in late 2023 and the beginning of 2024 in 126 animals in the southeast of England is likely to have occurred due to the incursion of infected midge vectors from the Netherlands in early- to mid-September.

Incursions from France are considered unlikely, given BTV-3-infected animals were not detected in France in 2023.

It is most likely that the 2 identified foci of infection in Kent and Norfolk resulted from separate vector incursion events rather than virus spread or movement within the country.

BTV-3 affected predominantly cattle in larger size holdings near the coast and/or having grazed in coastal marshland areas.

No clinical cases were detected in either cattle or sheep.

The level of spread within Great Britain and the risk of infected midges overwintering is unknown, although no new cases have been detected since 8 March and suspicious cases reports up to 18 March 2024 continued to be negative.

Acknowledgements

The views expressed in this report are those of APHA's National Emergency Epidemiology Group (NEEG). We would like to express our thanks to the Met Office, The Pirbright Institute and the many other APHA colleagues in the Service Delivery Directorate who have contributed to this investigation. The NEEG is comprised of staff from APHA's Professional Advice and Standards, Service Delivery, and Science Directorates.

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Annex A

Population density maps for cattle (Figure A1), sheep (Figure A2), and goats (Figure A3), with the former TCZs in Norfolk and Kent overlaid.

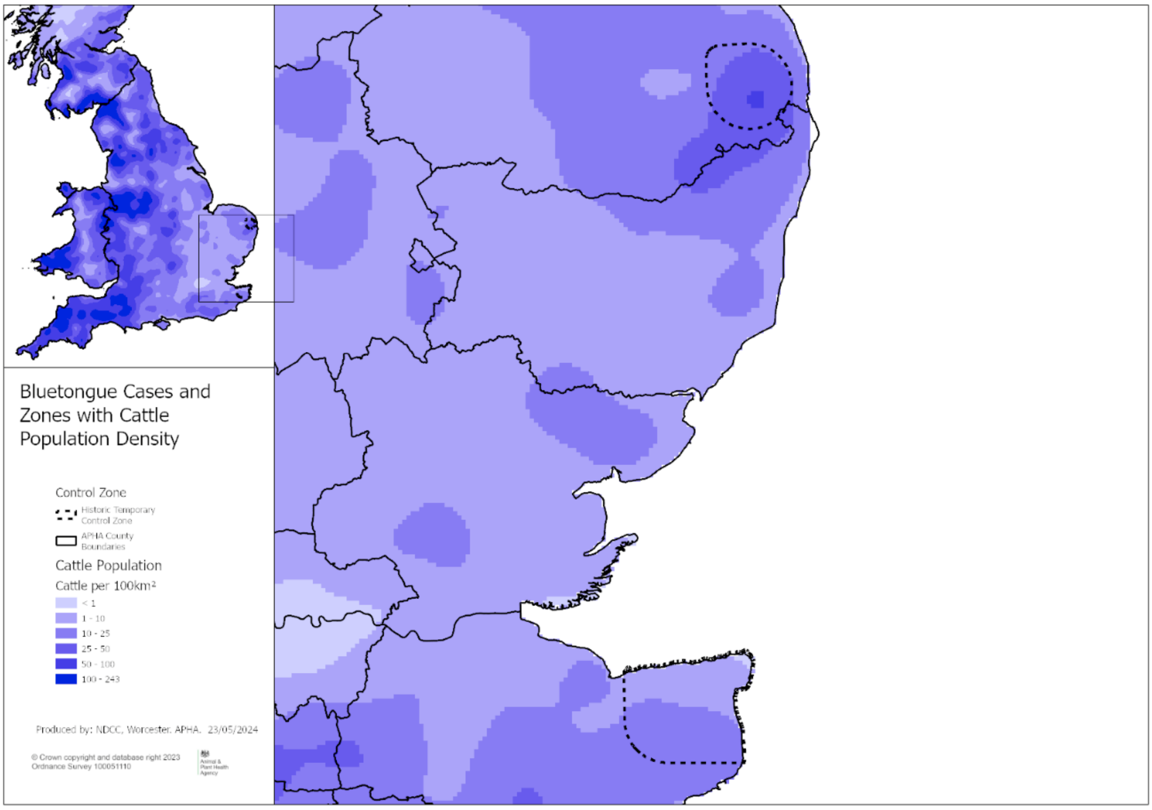

Figure A1. Cattle population density map with former Kent and Norfolk TCZs overlaid.

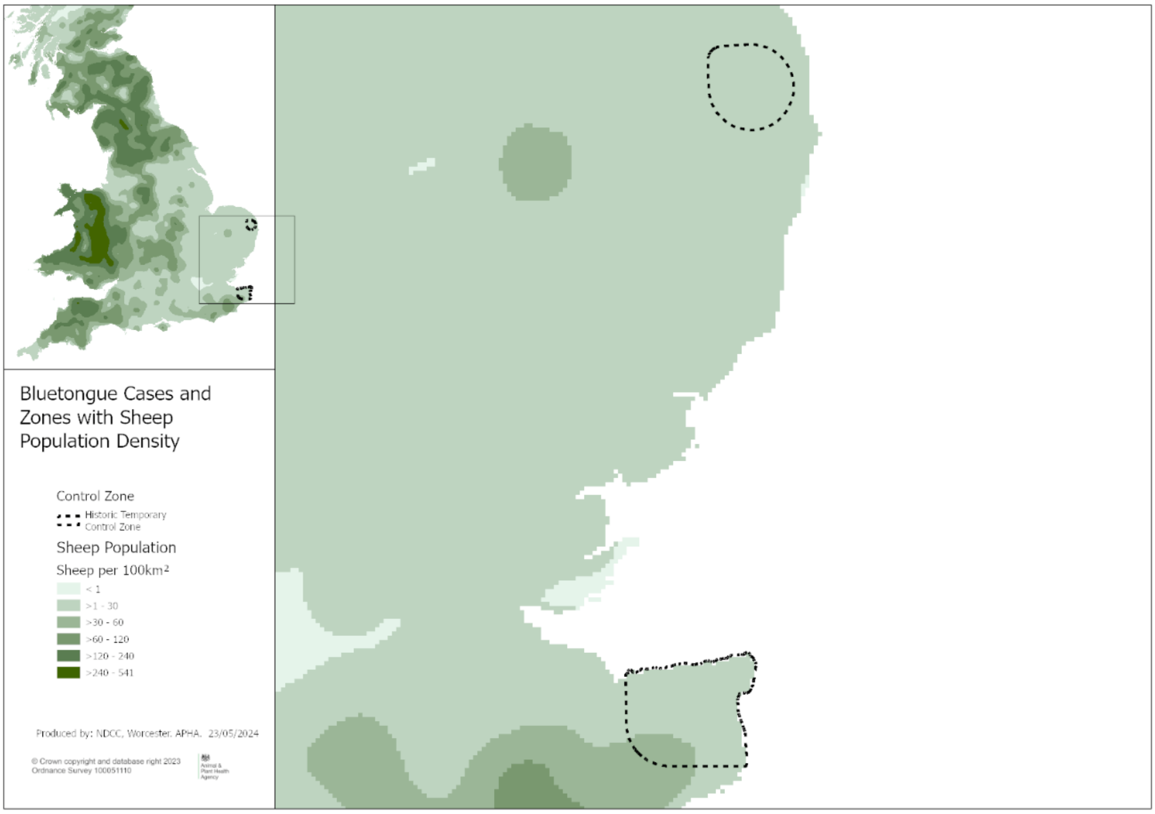

Figure A2. Sheep population density map with former Kent and Norfolk TCZs overlaid.

Figure A3. Goat population density map with former Kent and Norfolk TCZs overlaid.