

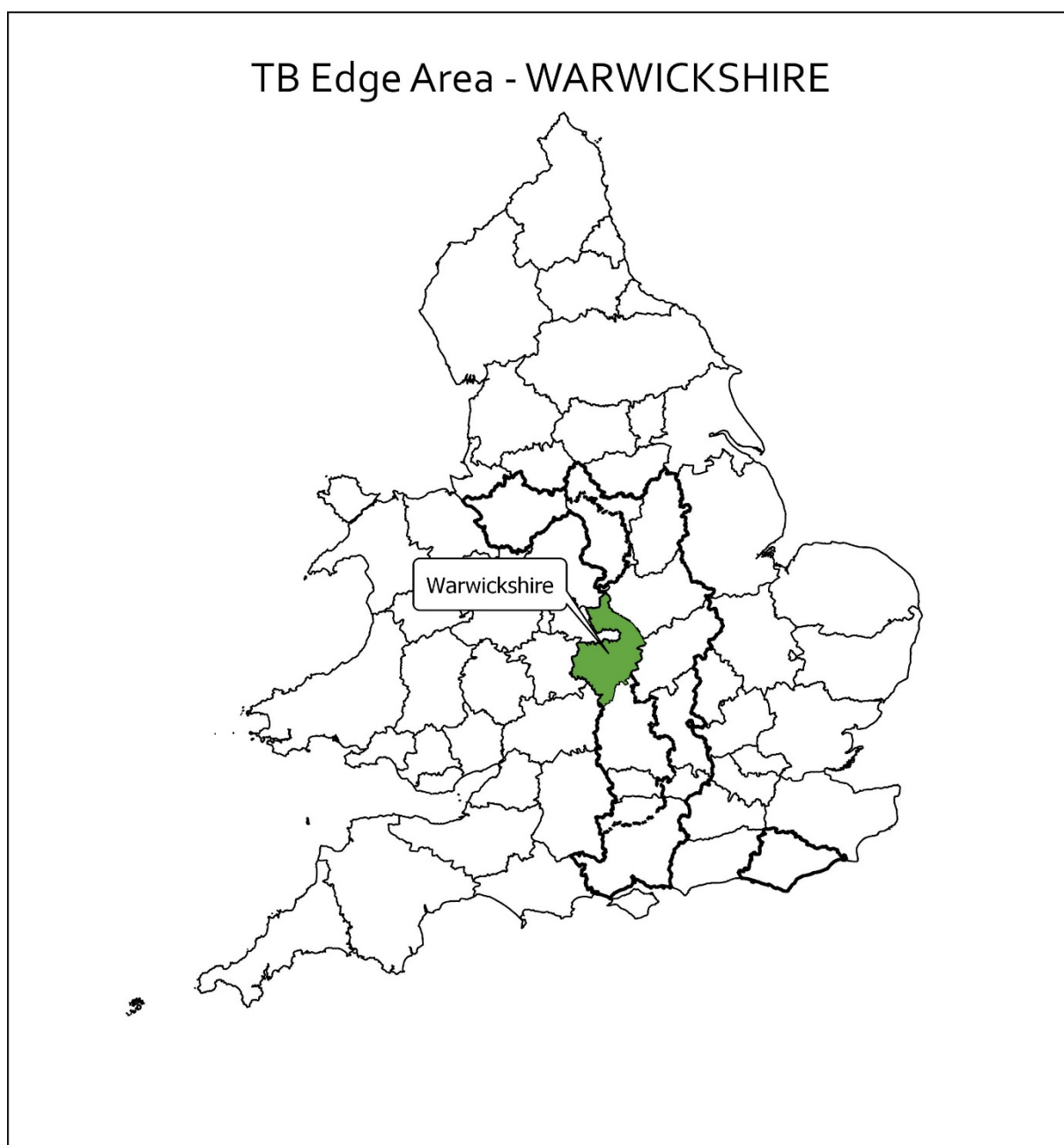


Year End Descriptive Epidemiology Report: Bovine TB Epidemic in the England Edge Area

Delivery Area: Northern

Name of County: Warwickshire

Year-end report for: 2018



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Executive Summary

1. The Edge Area has a low but recently rising incidence of infected herds. **Warwickshire** is part of the Edge Area that was established in 2013 as part of the Government's strategy to achieve Officially Bovine Tuberculosis Free (OTF) status for England by 2038. Originally, only the northern and eastern parts of the county were included in the Edge Area established in 2013. The rest of the county was part of the High Risk Area (HRA) until 1st January 2018, when the HRA portion of Warwickshire was incorporated into the Edge Area. This end of year report describes the bovine tuberculosis (TB) epidemic in the whole county of Warwickshire in 2018.
2. **Local cattle industry.** Small (up to 50 cattle) beef units are predominant in the county.
3. **New breakdowns of bovine TB.** The number of new breakdowns has been rising slowly over the last ten years. A slight decrease is noted between 2017 and 2018 from 84 to 80 breakdowns respectively in the whole county. This is despite an increased testing frequency and the incorporation of the former HRA into the Edge Area.
4. **Risk pathways for bovine TB infection.** Cattle-badger contact, cattle movement and residual infection are the most common risk pathways (in order of importance).
5. **Role of other species.** Badgers, and to a lesser degree, wild deer are involved in disease spread, acting as disease reservoirs. However no laboratory isolation of *Mycobacterium bovis* was undertaken in non-bovine species in 2018.
6. **Disclosing test.** The majority of breakdowns were disclosed at routine whole herd surveillance testing.
7. **Impact of bovine TB, reactor numbers.** A large increase in the number of TB reactors (total of 758) was mainly caused by the extension of interferon gamma testing to the former HRA of Warwickshire in 2018.
8. **Risks to the Low Risk Area.** Warwickshire is not contiguous to any of the Low Risk Area (LRA) counties and therefore does not pose a risk through local infection spread. However, Rugby Cattle Market, given its size and location, may well act as a disease dissemination route from cattle from the HRA and Edge towards the LRA.
9. **Risks from the High Risk Area and/or other adjacent Edge Area counties.** Warwickshire is under continuous risk of infection spread from the neighbouring HRA counties of Worcestershire and Gloucestershire. The Edge Area counties of Oxfordshire and Leicestershire adjoin Warwickshire - the cross border areas are very similar in terms of cattle density, breakdown incidence and disease risk pathways identified and therefore pose similar risks to each other. The border between Warwickshire and the Edge Area county of Northamptonshire has seen a recent increase in the number of incidents linked to wildlife, which may signal the early development of an area of endemicity.
10. **Forward look.** TB incidence is unlikely to drop within the next two years. Enhancement of cattle related measures will help to detect TB in cattle and reduce lateral spread of infection. Use of biosecurity measures such as informed purchasing of cattle, reduction of cattle-badger interactions and implementation of other wildlife (mainly badger) related measures are still required to address the most common risk pathways. The achievement of OTF status by 2038 is not likely.

Introduction

A key action in the implementation of the Government's objective to achieve Officially Bovine Tuberculosis Free (OTF) status for England by 2038 was to recognise the different levels of TB in different parts of the country and to vary the approach to control accordingly. To this end three management regions or zones have been established. Overall, the Edge Area has a low but recently rising incidence of infected farms and control efforts are seeking to slow down and reverse geographic spread, and reduce the incidence rate, with the aim of obtaining OTF status for this area as soon as possible. This report describes the epidemiology of bovine TB in Warwickshire which forms part of the Edge Area since its establishment in 2013 (see Appendix 1).

Changes to the Edge Area in 2018

On 1st January 2018 the Edge Area boundary was expanded westwards to absorb fully into the Edge Area the former HRA parts of the five previously split counties of Cheshire, Derbyshire, Warwickshire, Oxfordshire and East Sussex. The reports for those five counties will focus on incidents of bovine TB in the whole county, but noting key differences between the old and new parts where relevant.

From January 2018 annual routine herd surveillance testing was replaced by six monthly herd surveillance testing in the whole county of Warwickshire.

Cattle industry in Warwickshire

Herd types

There is a predominance of small herds of up to 50 cattle in the county (Figure 1), the majority of herds are beef cattle (61%), with dairy herds continuing to exist in the county (18%) (Figure 2).

Markets and livestock shows

There is one livestock auction market in Warwickshire - Rugby Farmers Mart located in Stoneleigh Park Agricultural Centre. There were six livestock shows taking place in the county in 2018.

Approved Finishing Units (AFU)

There were 3 new units approved in 2018 giving a total of 14 AFUs in the county. These units are all non-grazing (as required in the Edge Area) and, if correctly operated, are not considered a risk for introduction or spread of TB into the surrounding areas.

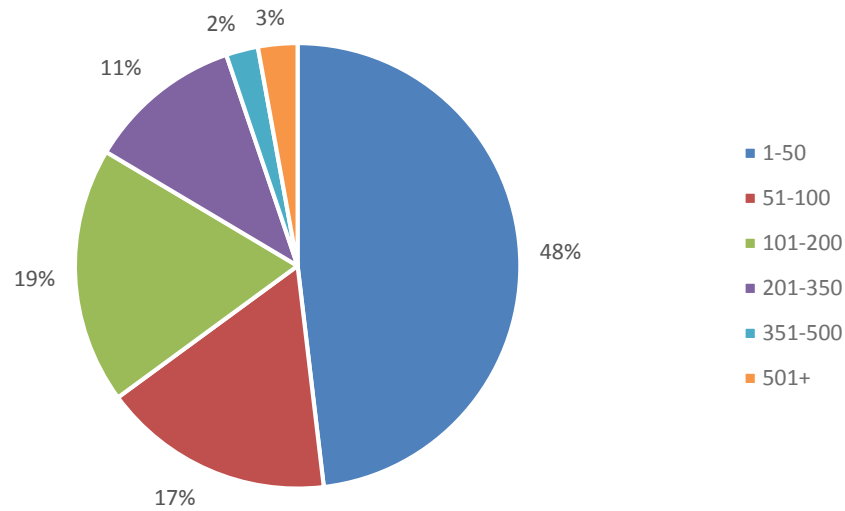


Figure 1: Proportion of cattle holdings by herd size in Warwickshire in 2018 (n=564)

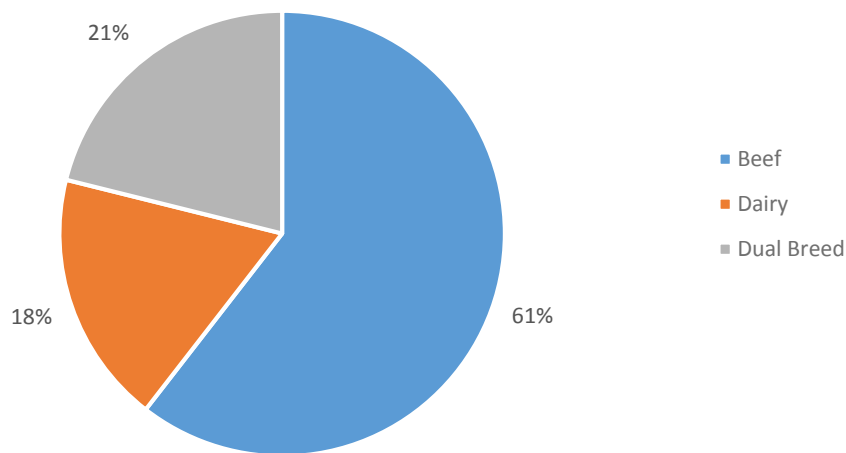


Figure 2: Proportion of cattle holdings by breed purpose in Warwickshire in 2018 (n=845)
 (Note: the total number of holdings in Figure 1 varies from the total number of holdings in Figure 2 because holdings are counted more than once when cattle with different breed purposes are present.)

Overview of bovine TB epidemic in Warwickshire

History of bovine TB in Warwickshire

Three measures are used to assess the level of bovine TB in this report.

Firstly, the number of new herd breakdowns that were disclosed in each year.

Secondly, the annual herd incidence rate, reported as the number of new incidents per 100 herd-years at risk (100 HYR). This is the number of new TB incidents detected in the year, divided by the time those herds were at risk of contracting TB. The 100 HYR incidence rate is used in this report as it

accounts for different intervals between tests in herds that other incidence measures, such as new TB incidents per number of herds or tests, do not¹.

Thirdly, the annual end of year herd prevalence. This is the number of herds under restriction due to a TB incident at the end of the reporting year, divided by the number of active herds at that same point in time, and provides a snap shot of the burden of TB on the local cattle industry.

For all three measures, both breakdowns where lesions at post-mortem or *M. bovis* in tissue samples have been identified in one or more animals (officially bovine tuberculosis free status withdrawn, OTFW) and breakdowns where lesions at post-mortem or *M. bovis* in tissue samples have not been identified (officially bovine tuberculosis free status suspended, OTFS) are included. However, TB incidents in approved finishing units (AFUs) without grazing are not included in the prevalence and incidence calculations in the Edge Area reports due to the limited epidemiological impact of these cases. Furthermore, herds restricted due to an overdue test rather than a TB incident are also excluded from calculations.

As illustrated by Figures 3a and 3b, the annual number of new TB breakdowns shows a fluctuating pattern with a rising plane over the last 10 years. This is similarly reflected in the annual incidence rates shown in Figures 4a and 4b. It is important to note that in 2018 annual routine surveillance testing was replaced by six monthly routine surveillance testing. Despite the expectation that the increased testing frequency would result in an increased number of new breakdowns and increased incidence rate in 2018, there was a decrease compared to the previous year. This may be because six monthly routine surveillance testing was implemented after completion of a herd's annual routine test in 2018. It is therefore likely that the number of new breakdowns and incidence will rise in 2019 as a result of full implementation of six month routine surveillance testing.

Another explanation of a slight decline in the number of new TB cases might be that the breakdowns take longer to resolve. There are no figures to compare the average breakdown lengths with previous years (due to the fact that the county was previously split into two risk areas) but the increased prevalence suggests that this is the case (Figure 5a and 5b – rising prevalence). The longer the breakdown takes to resolve the less chance there is for that holding to have a new breakdown in the same year.

¹The 100 HYR incidence rate measure is described further in 'Bovine tuberculosis in Great Britain in 2018: Explanatory Supplement to the annual reports' <https://www.gov.uk/government/publications/bovine-tb-epidemiology-and-surveillance-in-great-britain-2018>

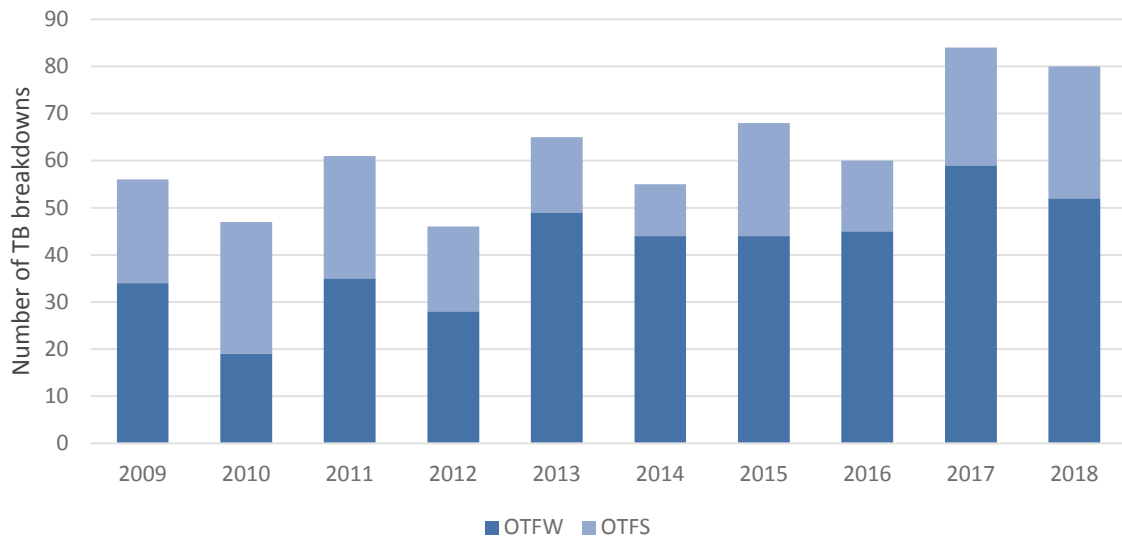


Figure 3a: Annual number of new TB breakdowns in Warwickshire 2009-2018

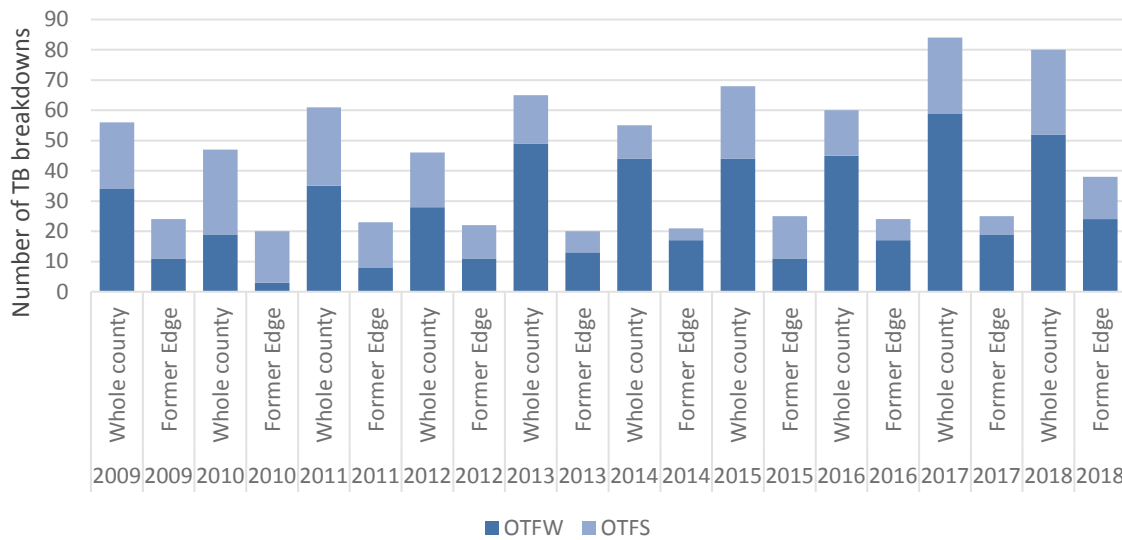


Figure 3b: Annual number of new TB breakdowns in Warwickshire 2009-2018 for previously split county.

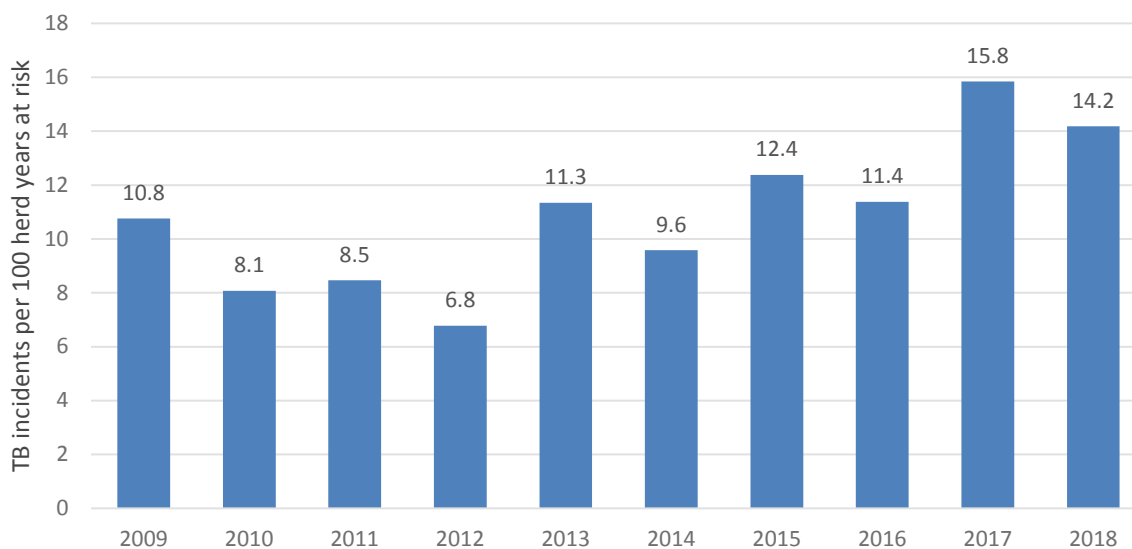


Figure 4a: Annual incidence rate (per 100 herd-years at risk) for all new breakdowns (OTFS and OTFW) in Warwickshire, 2009-2018

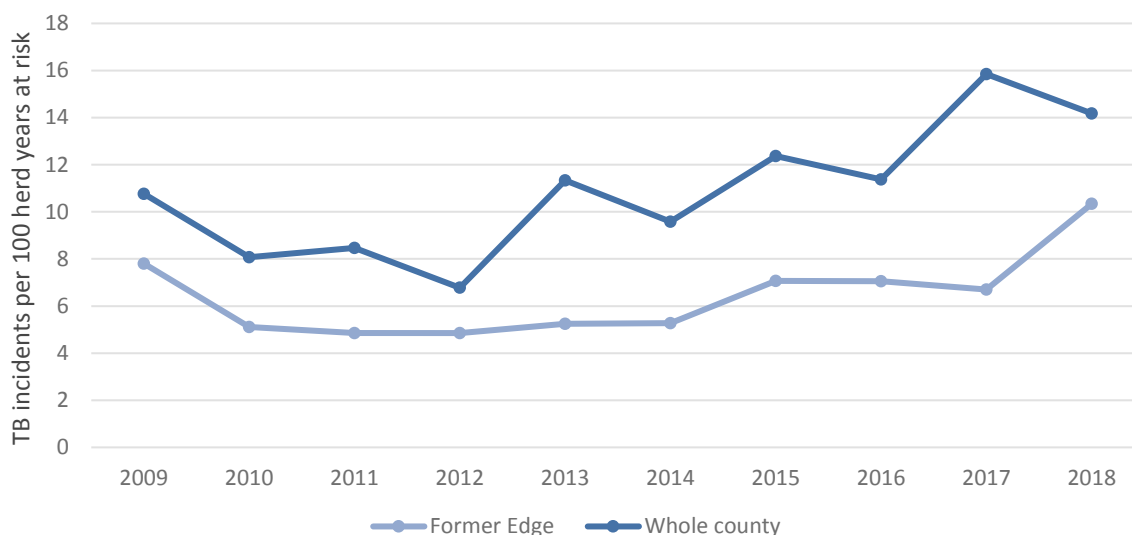


Figure 4b: Annual incidence rate (per 100 herd-years at risk) for all new breakdowns (OTFS and OTFW) in Warwickshire, 2009-2018 for previously split county

Figure 5a below illustrates the percentage of herds in Warwickshire which were under TB restrictions at the end of 2018. This includes herds which had restrictions imposed on them in 2018 as well as those which were restricted prior to 2018 but had not achieved OTF status by the end of 2018. The duration of TB breakdowns will have a direct effect on prevalence. The longer the breakdown the higher the prevalence.

Prolonged breakdowns and increased prevalence is related to endemicity of the disease, especially in areas of Warwickshire previously classed as HRA. Difficulties in breaking wildlife related risk pathways often result in repetitive reinfection of cattle and prolonged breakdowns.

The increased application of interferon gamma testing can also prolong breakdowns and thereby increase prevalence. Since parallel application of skin and interferon gamma testing increases the overall test sensitivity (i.e. the probability of identifying infected animals), breakdown duration may be increased by identifying animals that would otherwise have been missed. This effect is also likely to reduce incidence in the medium and long terms by reducing TB spread within and between herds, lowering the rate of recurrence and decreasing the chances of exposing wildlife to the infection.

Another reason for breakdowns taking a long time to resolve is the fact that short interval (SI) tests are scheduled to occur at a minimum of 60 days from reactor removal (as opposed to 60 days from reactor disclosure and isolation). This recent policy change may have an impact on the duration of all breakdowns.

The increase in breakdown duration can be also caused by tighter APHA administration processes. In recent years APHA has increased its checks on submitted TB test charts. Herd movement restrictions cannot be lifted until all eligible animals are accounted for. Any animal identification issue needs to be rectified before the herd can regain its OTF status. Also a prompt submission of Cleansing and Disinfection declarations (BT05) from the farmer is required in order to lift TB restrictions. Delays in BT05 submission and animal identification problems can trigger further testing and thereby prolong breakdowns.

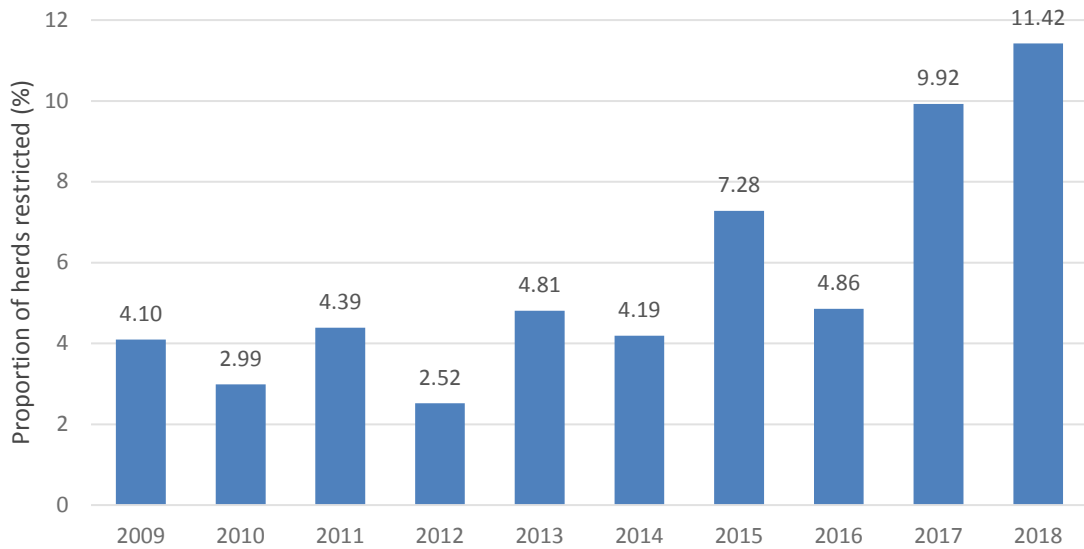


Figure 5a: Annual end of year prevalence of restricted herds in Warwickshire, 2009-2018

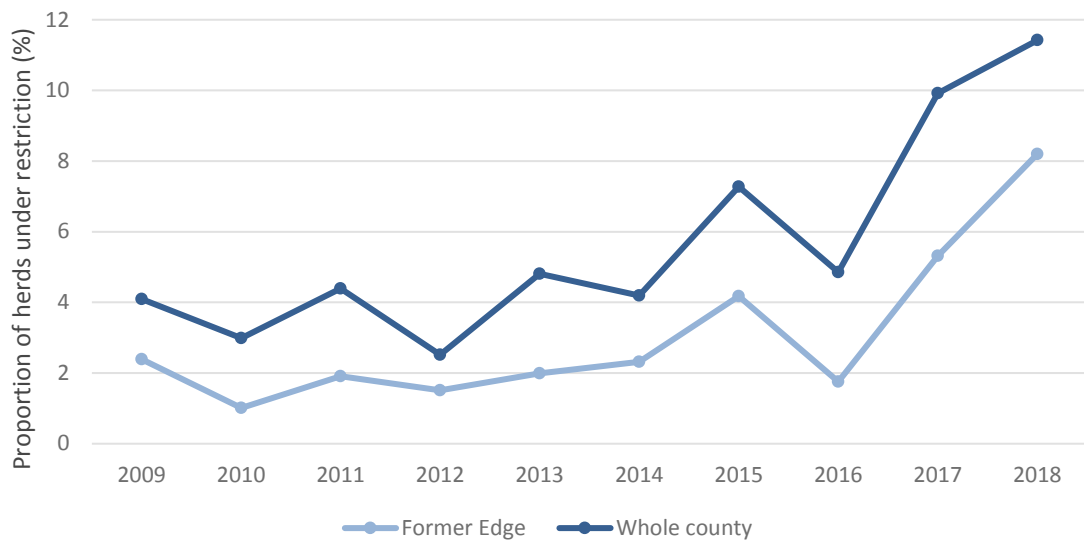


Figure 5b: Annual end of year prevalence of restricted herds in Warwickshire, 2009-2018 for previously split county

Geographical distribution of bovine TB cases (new and ongoing) in Warwickshire

As shown in Figure 6 the geographical distribution and occurrence of TB cases is higher mainly in the former High Risk Area of the county (south west). This is also closely related to suspected wildlife reservoirs of TB in this area. (Figures 7 and 8). Previous years' reports for the original Edge Area portion indicated TB incidence to be related to cattle density (the higher cattle density the higher number of TB cases). This relationship however is not clearly seen in this reporting year with distribution of cases appearing to be mainly unrelated to cattle density.

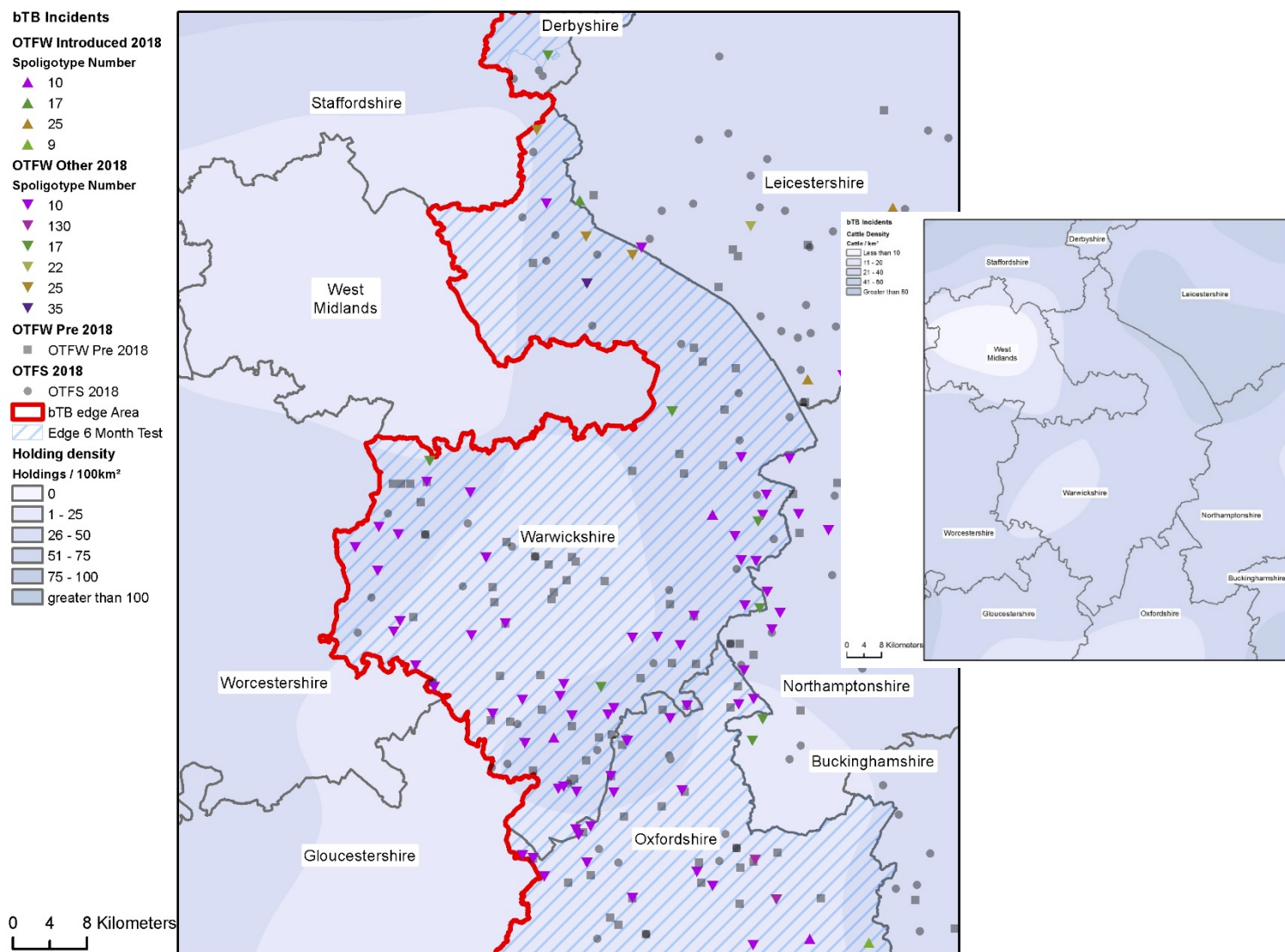


Figure 6: Geographical distribution of all new TB breakdowns (OTFW and OTFS) in 2018 and pre 2018 OTFW breakdowns still ongoing at the end of the report period overlaid on a cattle holding density map, with a cattle density map for the area inset

Figures 7 and 8 below illustrate wildlife involvement in TB breakdowns in 2018. Wildlife in this context refers to species of wild mammals which can act as reservoirs of *M. bovis*, for example, badgers and potentially wild deer. Warwickshire is a county with 65 nature reserves and several big farming estates providing a suitable habitat for badgers as well as deer. Both species are reported to be very active in certain parts of the county.

Suspicion of *M. bovis* infection within populations of wildlife is a first indication of the disease becoming endemic in an area.

Figures 7 and 8 below show higher TB incidence in the former High Risk Area of Warwickshire and a lower incidence in areas above the M40 motorway. It can indicate that major roads like the M40 may serve as barriers for wildlife migration and therefore slow disease spread. It is difficult to make a comparison of behaviour of these breakdowns with previous years as there are no previous epidemiology reports for the former High Risk Area part.

It is however evident that certain *M. bovis* genotypes tend to form clusters even when observed on a single year basis, as clearly shown in Figure 7 below. This is an indication of a local spread which could be due to direct contact between cattle from different herds or most likely from wildlife contact, given the widespread geographical dispersion of certain genotypes.

Figures 7 and 8 show how wildlife related cases appear to delineate the more likely endemic areas.

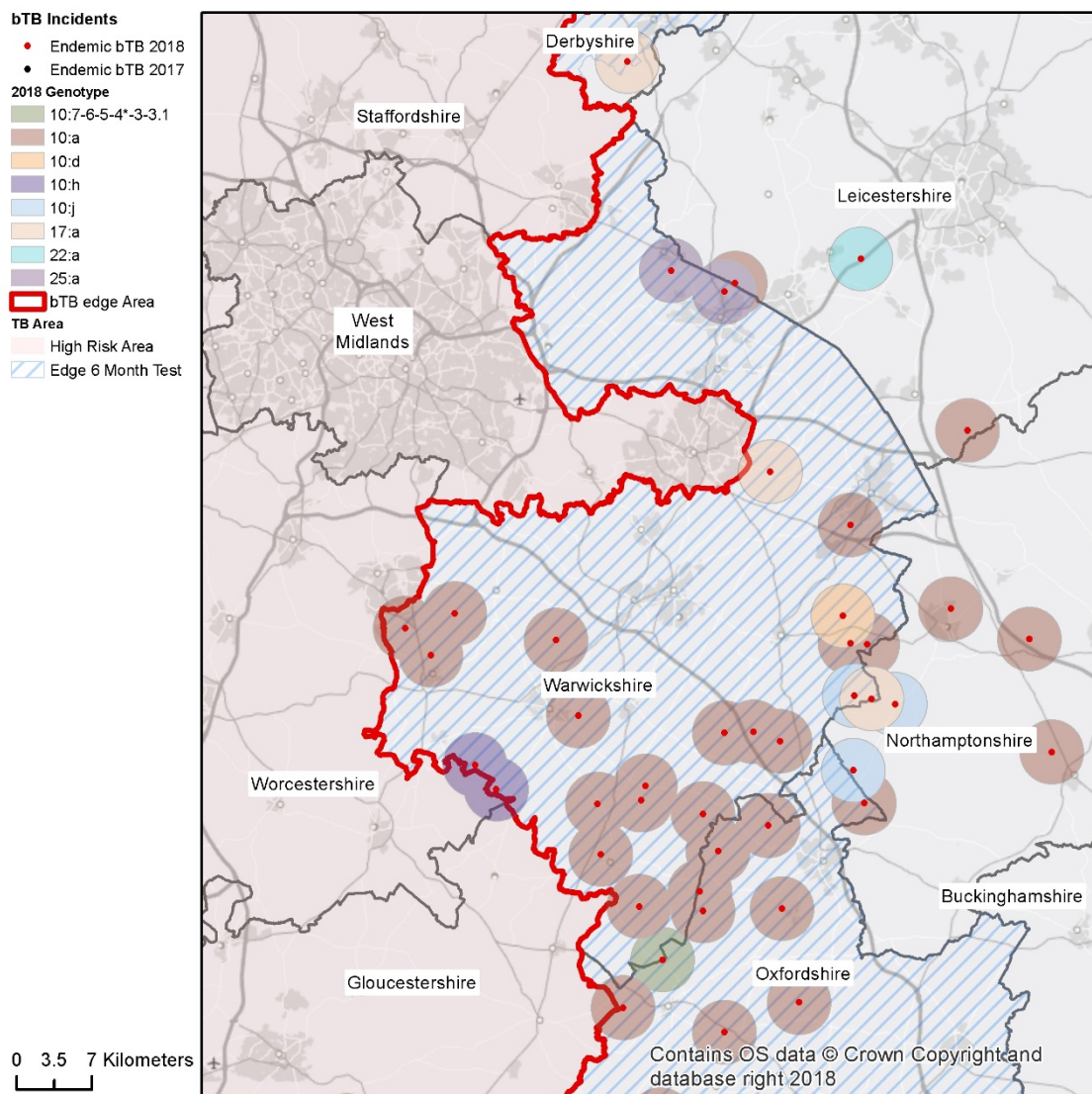


Figure 7: Genotypes detected in Warwickshire in 2018, where a wildlife source was attributed with a 75% certainty or above, as an indication of endemicity within local wildlife populations (OTFW breakdowns only).

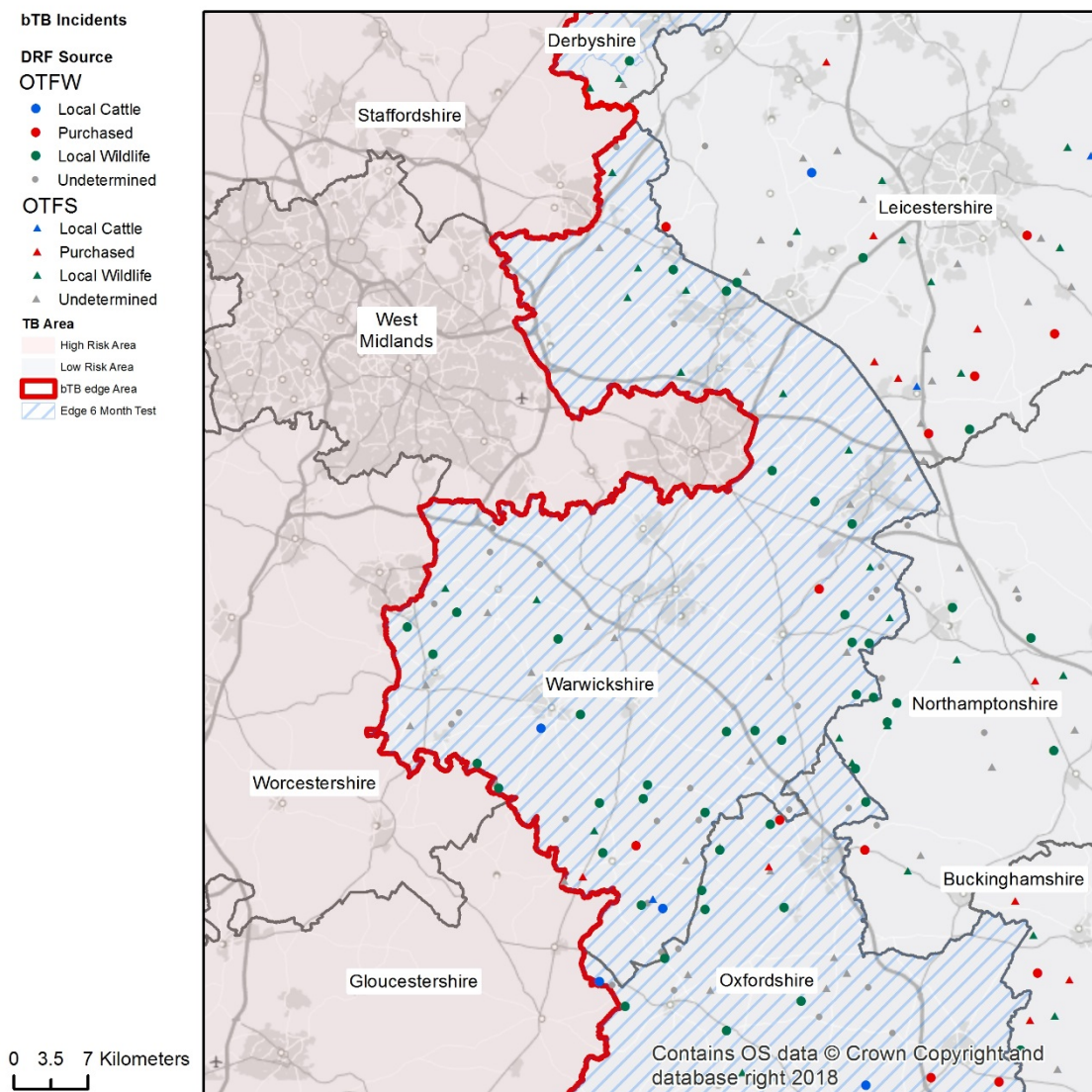


Figure 8: The source of infection recorded with the highest level of certainty, for all TB breakdowns (OTFW and OTFS) that were new in 2018

Descriptive epidemiology of bovine TB in Warwickshire

Characteristics of bovine TB in Warwickshire

Figure 9 below shows the number of TB breakdowns by herd size and type. Breakdowns were most numerous in herds consisting of 101 – 200 cattle, followed by herd sizes 51-100 then 1-50 and 201-350. However, herds with more than 500 cattle were slightly more frequently disclosed with disease compared to herds with fewer cattle (3% of herds with more than 500 heads accounted for 5% of the breakdowns). Sixteen percent of all cattle herds in Warwickshire have more than 200 cattle but this group accounted for nearly 24% of all breakdowns. This mirrors trends observed in other counties and in the country as a whole where larger herds tend to have an increased risk of TB infection.

Figure 9 also illustrates the number of TB breakdowns by herd type. Beef herds account for the majority of breakdowns and this may be a reflection of the fact that beef cattle are the predominant herd type in Warwickshire.

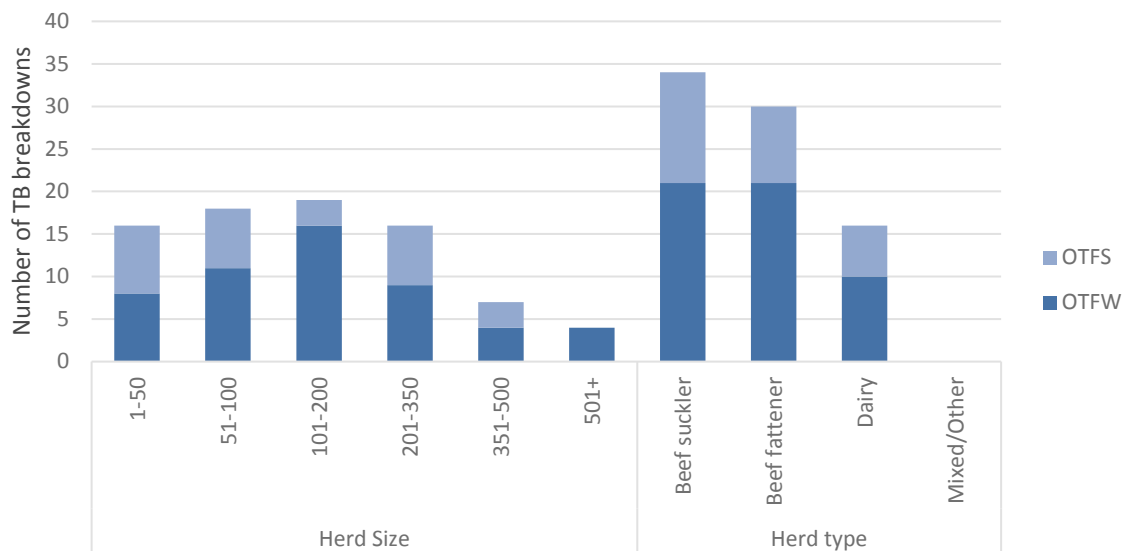


Figure 9: Number of new TB breakdowns (OTFW and OTFS) in the county, by cattle herd size and type

As shown in Figure 10, the largest number of breakdowns was reported in November (17 breakdowns) followed by March, September and October (9 breakdowns in each of these months). This can be explained by the farmer's preference to undertake routine surveillance testing either after cattle finish their grazing season in autumn or before turning cattle out to grass in early spring.

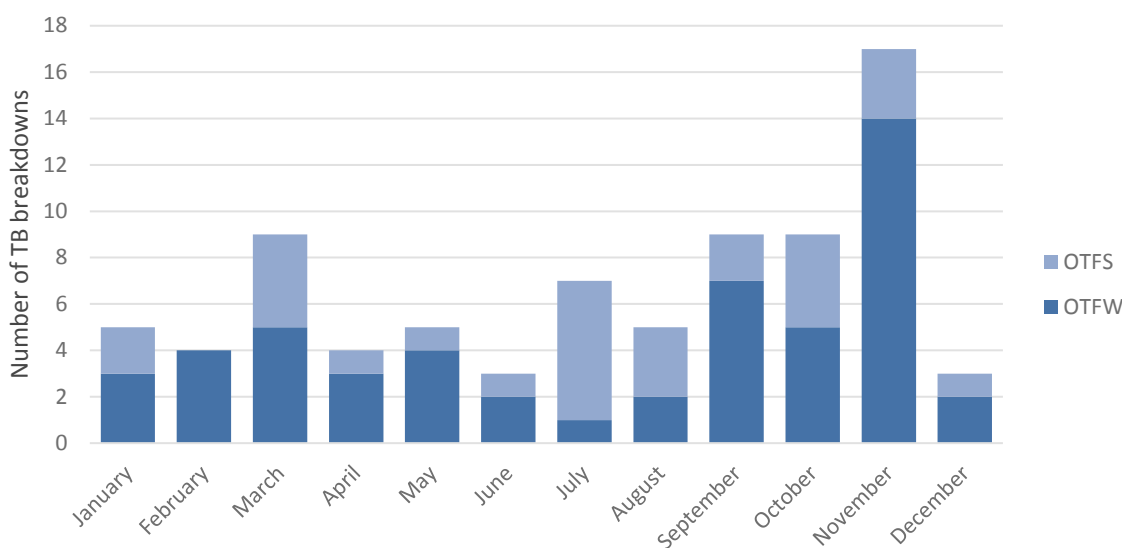


Figure 10: Number of new TB breakdowns (OTFW and OTFS) in the county, by month of disclosure

To characterise the strain of TB infecting an animal, APHA laboratories carry out DNA typing of *M. bovis* isolates. As shown in the graph in Figure 11 below, the most common genotype in Warwickshire is 10:a. This genotype was found in 37 breakdowns (72%). This genotype is also very common in the neighbouring counties of Oxfordshire and Gloucestershire. Genotype 10:a is associated with wildlife: as was seen in Figure 7 genotype 10:a was confirmed in the majority of cases (17 out of 25) where wildlife is believed to be the source of disease. The second most common genotype is 17:a (5 cases).

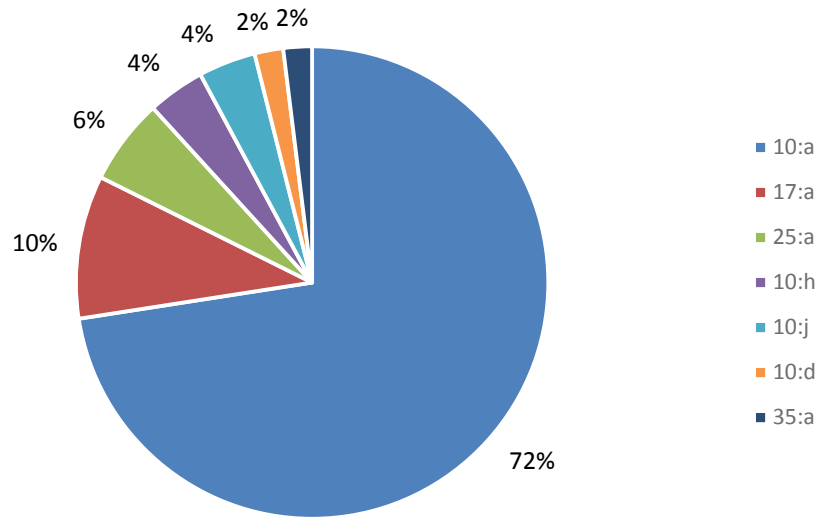


Figure 11: Genotypes of *M. bovis* (OTFW only) identified in the county in 2018 (n=51).

Most of the breakdowns in Warwickshire (44 cases) cleared within 151-240 days from the initial reactor disclosure date (Figure 12). Only a very small proportion (4 herds) were under restrictions for less than 150 days. Five herds were reported as persistent breakdowns where the amount of time spent under TB restrictions exceeded 551 days (18 months), with one herd being under TB restrictions from January 2014 (ongoing).

The breakdown duration has a direct effect on prevalence. Prolonged breakdowns can cause the prevalence level to increase. Figure 5a and its interpretation describe some of the reasons for breakdowns taking longer to resolve.

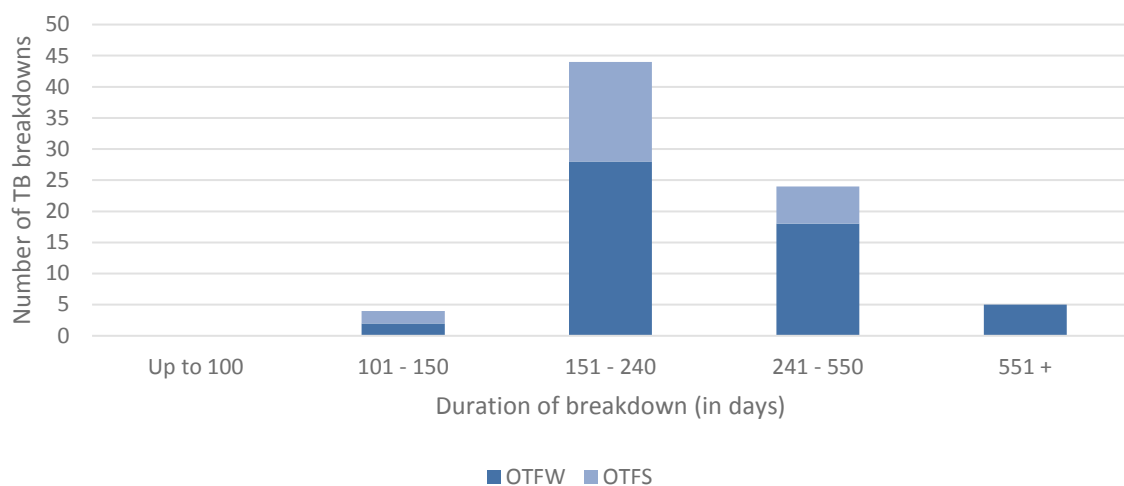


Figure 12: Duration of closed TB breakdowns (OTFW and OTFS) in the county in 2018

Risk pathways for TB infection in Warwickshire

Establishing the route of entry of infection into a herd experiencing a new TB incident can be challenging. The Animal and Plant Health Agency (APHA) aims to complete an epidemiological assessment of all TB incidents in the Edge Area (both OTFW and OTFS), including a thorough on-farm investigation. However where resource constraints exist, as many new incidents as possible are randomly selected or triaged for an investigation visit. Scrutiny of routinely collected data such as cattle movements and *M. bovis* genotypes (available for OTFW incidents only), combined with data from the on-farm investigation and knowledge of the local area epidemiological situation provides information which enables APHA case vets to assess and then rank the possible disease pathways.

A mathematical algorithm based on risk pathway data was used for the 2018 period to determine the relative contribution of different sources for each breakdown herd. However, this methodology also included those incidents where certainty about risk pathways was lower because of gaps in the epidemiological evidence. The effect of uncertainty has been increased by the inclusion of OTFS herds, where by definition, no genotype was determined. Therefore the relative proportions of each risk pathway are very approximate, and broad generalisations only can be made from these data.

A more detailed description of this methodology is provided in the Explanatory Supplement.

According to the assessments described above and illustrated in Figure 13, for TB cases new in Warwickshire in 2018, the infection source was attributed to badgers in 60% of cases. This includes cattle exposure at grazing as well as at housing. It is difficult to compare these data with previous years' data as no reports were created for the former High Risk part of Warwickshire.

If compared to infection sources in other counties of the Edge Area, badgers play a significant role as a suspected source of infection. However the following counties report an even higher percentage of breakdowns with a suspected badger source: Derbyshire 77%, Cheshire 66%, and Northamptonshire 63%. The county reporting the lowest percentage of cases attributed to badgers in the Edge area is Hampshire 23%.

Figure 14 below shows that the number of TB breakdowns attributed to badgers is much higher for beef fatteners and suckler herds than for dairy herds. This may be due to the number of beef herds being much higher than the number of dairy herds.

Cattle movement is responsible for almost 13% of TB breakdowns. The only Edge county reporting lower percentage here is Derbyshire (10% attributed to purchased sources) with Buckinghamshire being a county with the highest number of breakdowns attributed to cattle movement (57%). Counties with less evidence of endemic infection in wildlife have a greater proportion of cases resulting from cattle movements. Counties with more evidence of endemic infection in wildlife may have similar or more cases due to cattle movements but because the number of cases due to wildlife is higher the proportion attributable to cattle movements is relatively low.

With Warwickshire being contiguous to the High Risk Area along its western boundary (Staffordshire, West Midlands, Worcestershire and Gloucestershire), it is to be expected that cattle movement is a source of TB infection to Warwickshire as many farmers try to source their cattle locally.

Figure 14 below shows that cattle movement as a source of infection is a risk factor for beef fatteners but appears to be less so for suckler and dairy herds. This is potentially related to the number and frequency of cattle purchases. The business model of fattening herds relies upon frequent purchasing of cattle and so comes with an associated risk of buying infected animals.

Other wildlife sources (which in the case of Warwickshire refers mainly to wild deer) is suspected to cause a similar number of breakdowns (12%) to cattle movement. Other wildlife as a source of infection is also reported in other Edge counties like Berkshire (17%), Nottinghamshire (17%) and Hampshire (13%). The remaining Edge counties report significantly lower numbers of cases attributed to other wildlife (between 0.52% and 3.6%). The reasonably high number of cases attributed to deer can be explained by the fact that there are significant populations of wild deer in Warwickshire.

Residual infection is believed to be responsible for almost 9% of breakdowns. More information about the reasons for the residual infection can be found in the “Detection of cases in Warwickshire” below.

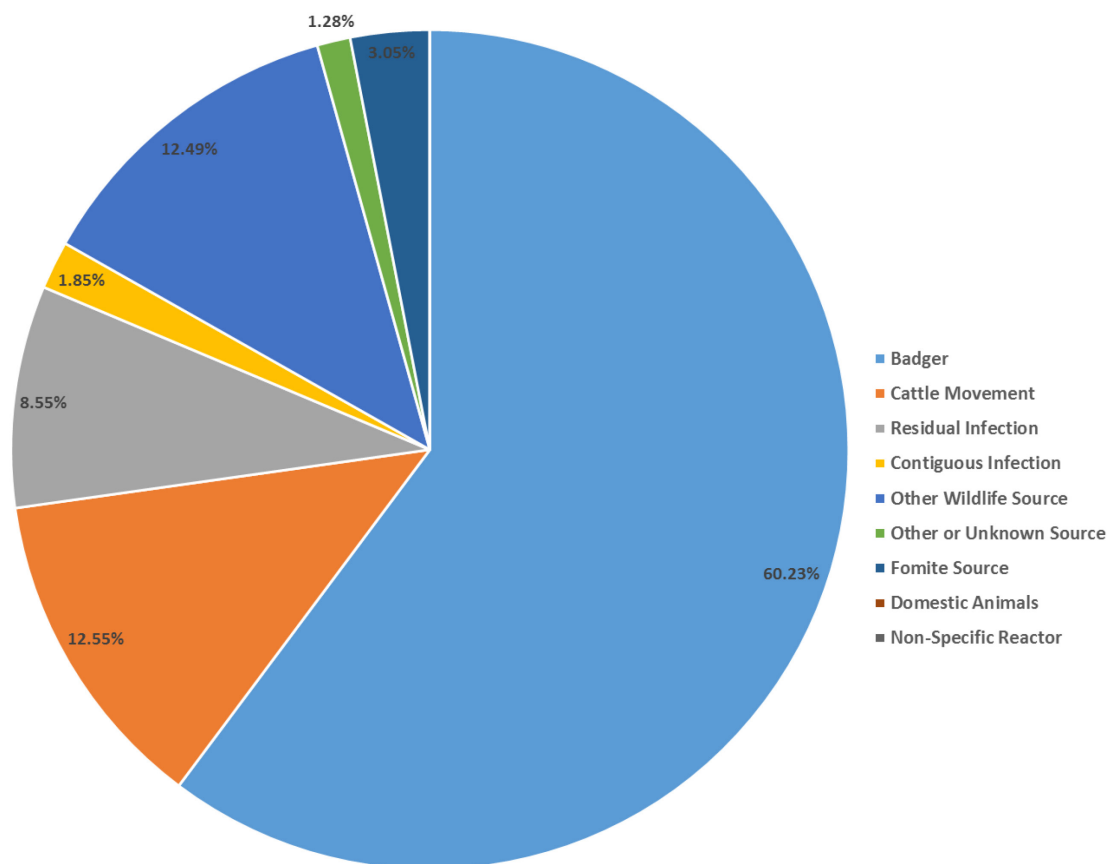


Figure 13: Summary of the weighted source of infection attributed for all incidents (both OTFW and OTFS) new in Warwickshire in 2018

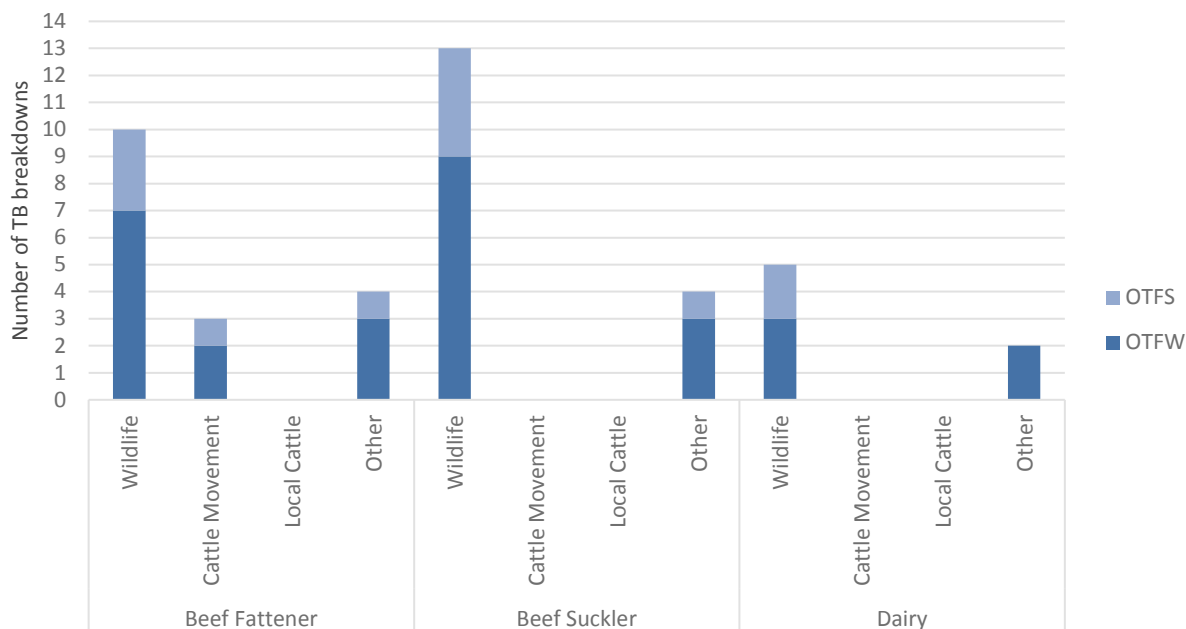


Figure 14: Source of infection recorded with the highest level of certainty for all TB breakdowns (both OTFW and OTFS) in Warwickshire, by herd type.

Role of other species in Warwickshire

Badgers and other wildlife

Warwickshire is a county with a high number of nature reserves and large farming estates creating a good wildlife habitat. The population of badgers and deer is large and active. Although there have been no laboratory confirmed isolations of *M. bovis* in wild animals such as badgers or wild deer in 2018, their role in disease transmission is believed to be significant considering the epidemiological evidence as illustrated by Figures 7, 8, and 13. The Defra funded Edge Area found-dead badger survey should provide some information about the prevalence of *M. bovis* in badgers in Warwickshire. The results of this survey are not yet published.

The Warwickshire Badger Group is a privately-funded group currently holding a badger vaccination licence. In 2018 there were 17 badgers trapped and vaccinated in the county. This took place over three different landowner sites at a total of six setts.

There is a large wild fallow deer population in the parish of Shuckburgh bordering Northamptonshire. There were two TB breakdowns in this area in 2018 attributed to a possible wildlife infection source. This may present a disease risk to the neighbouring Edge Area county of Northamptonshire.

Other domestic species

There has been no laboratory confirmed isolation of *M. bovis* in domestic non-bovine farm animals (camelids, goats, sheep, pigs), pets, zoo animals and farmed or park deer in 2018.

Detection of cases in Warwickshire

The majority of TB cases (52 out of 80) were disclosed by routine whole herd surveillance testing, as shown in Figure 15. In 2018 the routine surveillance testing interval frequency changed from twelve to six months. This change was introduced after the completion of herds' annual routine tests for 2018. Therefore six month testing was not uniformly implemented across all holdings in 2018. The full effects of this change should be seen more clearly in 2019. The second most frequent type of test disclosing

TB reactors was the 6M test carried out six to eight months after conclusion of a breakdown and revocation of cattle movement restrictions. Twelve breakdowns in 2018 were disclosed at the 6M test.

There are a number of reasons for breakdowns recurring at 6M tests. One reason being the inability to eliminate the risk pathways which could lead to another breakdown. This is especially relevant in Warwickshire as an area with pockets of endemic TB and suspected wildlife involvement. Another reason is the potential for skin testing alone to fail to disclose every infected animal in a herd. This is due to the skin test having to achieve a balance between sensitivity (proportion of infected animals identified by a test) and specificity (proportion of uninfected animals identified as such by the test) with the risk of truly infected animals not being detected (false negatives). By applying interferon gamma testing together with the skin test the overall sensitivity of the test is increased with a small reduction in specificity. In this way more infected animals are identified at the risk of taking a very low number of animals not truly infected (false positives). Inadequate cleansing and disinfection of premises as well as inadequate manure and slurry management can also lead to reinfection.

As shown in Figure 13, 8.5% of breakdowns in Warwickshire in 2018 are likely to have occurred as a result of residual infection within the herd. Undetected infected animals from previous incidents maintain infection within the herd and pose a risk of further spread through cattle movements out of the herd. The importance of pre-movement testing is emphasised by the fact that two breakdowns were disclosed through pre-movement testing in Warwickshire in 2018.

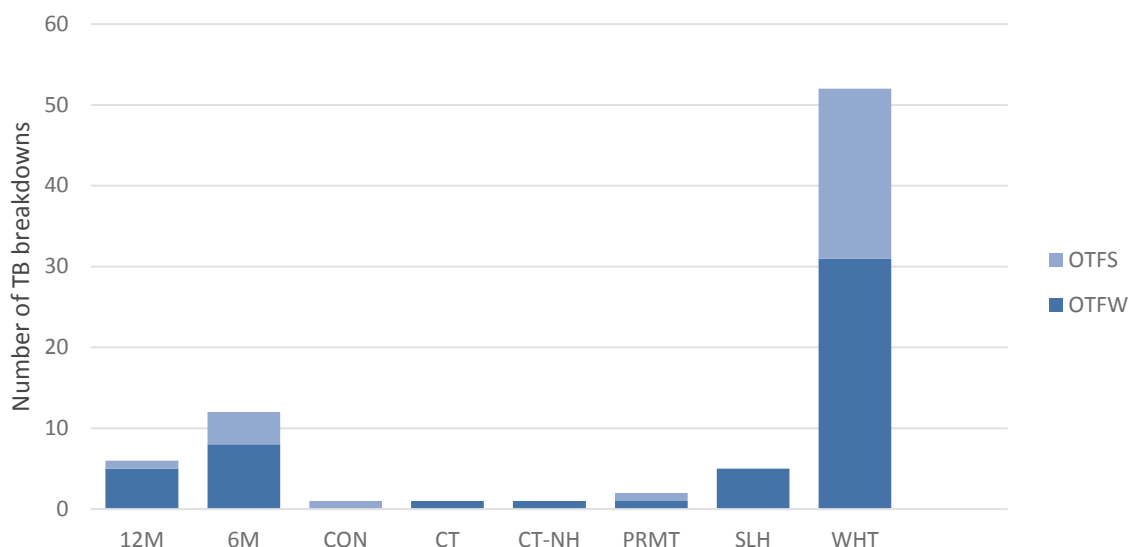


Figure 15: Number of TB breakdowns (OTFW and OTFS) in Warwickshire new in 2018, disclosed by different surveillance methods (surveillance method types are further described in the Explanatory Supplement¹).

Figure 16 below shows that 26 breakdowns in 2018 had experienced a breakdown in the previous three years. These 26 cases consist of 7 OTFS cases and 19 OTFW cases. The reasons for disease recurrence are explained above.

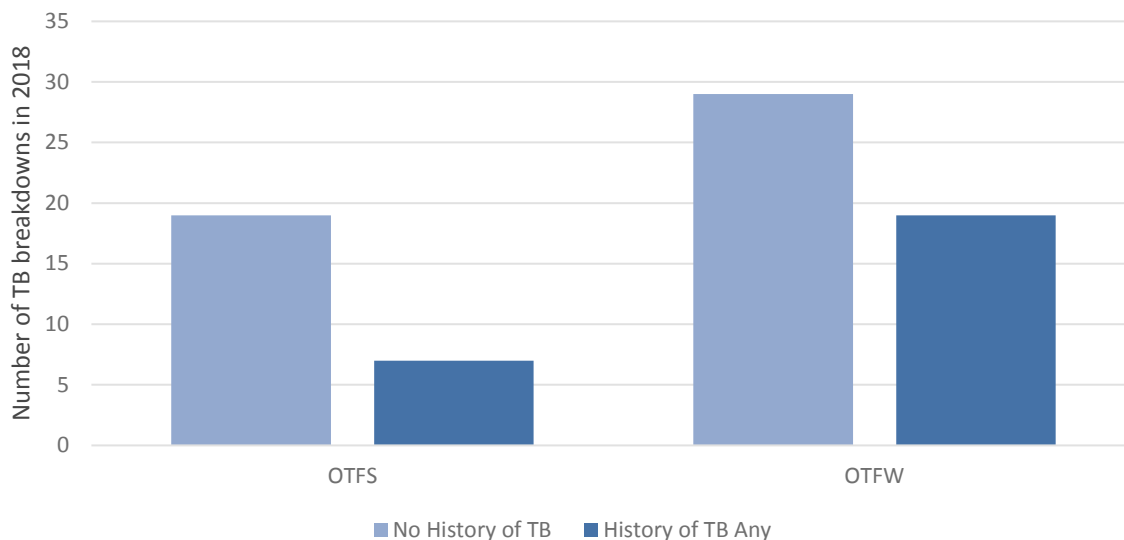


Figure 16: Number of TB breakdowns (OTFW and OTFS) in Warwickshire which experienced a breakdown in the previous 3 years

Burden of bovine TB

Bovine TB in cattle in Warwickshire represents a significant and increasing financial burden for farmers and taxpayers.

In 2018, 758 cattle were disclosed as TB reactors in Warwickshire: 426 animals were skin test reactors and 332 were disclosed by interferon gamma testing alone (skin test negative or IRs). As illustrated by Figure 17 below these numbers are higher than in previous years. A very significant increase in the number of interferon gamma reactors can be explained by the extension in 2018 of the Edge Area to include the former High Risk Area and the extension of interferon gamma testing to that area. Increasing the routine herd surveillance testing frequency from twelve months to six months also affected the number of skin test reactors disclosed, as infected cattle are being identified earlier.

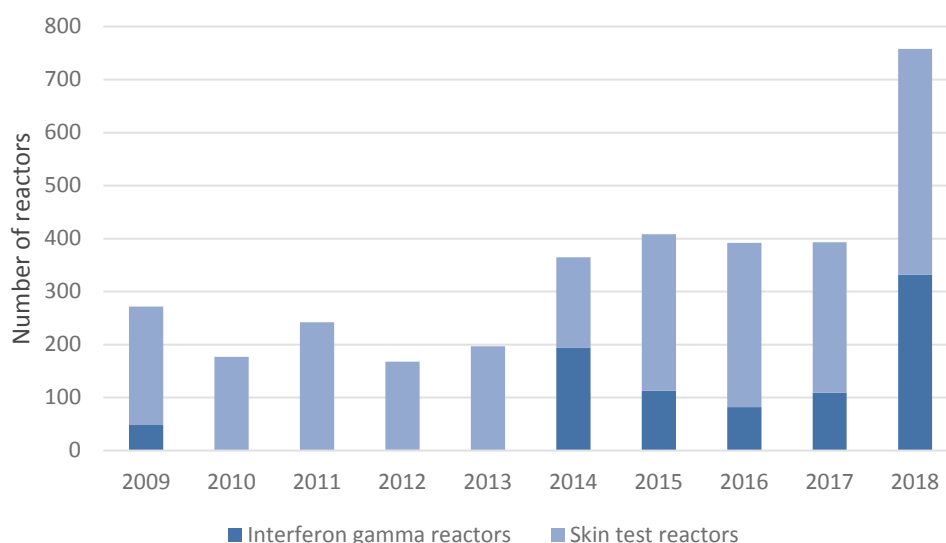


Figure 17: Number of reactors detected by interferon gamma and skin tests in Warwickshire, 2014 to 2018

Key drivers of the bovine TB epidemic

Infected wildlife

As illustrated in the risk pathways section above and Figure 13, badgers are deemed to be a significant source of bovine TB in the county and one of the key drivers of the epidemic. Other wildlife sources such as wild deer may play a role too. Warwickshire shares its boundaries with Worcestershire and Gloucestershire – counties of a high TB incidence, and over time a tendency of the disease to spread in a north easterly direction can be seen. The frequency of detection of genotype 10:a within breakdowns attributed to wildlife is an indication of TB endemicity within the local wildlife population. This is a very problematic driver of the epidemic due to limited measures applied to control TB within the wildlife population. There is also some uncertainty around the levels of infection in the wildlife (badgers and deer) population and the levels of direct and indirect contact with cattle.

The Defra-funded TB Advisory Service (TBAS)² offers farmers free bespoke advice on TB related biosecurity including advice on cattle / badger contact prevention.

Cattle movement

Cattle movement is the second most important driver of the TB epidemic and is believed to be responsible for 12.5% of new breakdowns. It is increasingly difficult for farmers to source cattle from holdings with no recent TB history. Also the fact that some of Warwickshire's neighbouring counties are HRA counties means there is an increased risk of buying cattle with residual TB infection when buying locally.

An industry led TB accreditation scheme regulated by the Cattle Health Certification Scheme (CHeCS) was established in 2016 to try to encourage farmers to minimise risk when buying cattle. The TB Advisory Service puts a lot of emphasis on safe cattle purchasing practices during their advisory visits. Other tools introduced to encourage safe sourcing of cattle is the ibTB database³ showing the location of current and historic TB breakdowns. The Farm Level TB reports issued to farmers during breakdowns are also useful as they help to demonstrate the risk related to purchasing cattle for individual farms.

Recurrence and persistence

Recurrence of TB within herds is common and 26 breakdowns in 2018 had experienced an OTFW breakdown in the previous three years. This is mainly due to farmers not being able to eliminate the risks which led to the herd contracting TB previously and also due to residual, undisclosed TB infection within those herds. There were five breakdowns classed as persistent (those that last for 18 months or more). Both recurrence and persistence are important drivers of the bovine TB epidemic. Apart from limiting the risks by responsible cattle sourcing and managing cattle and badger contact, prevention by adequate cleansing and disinfection of infected farms as well as safe manure and slurry management are effective measures to minimise the risk of recurrence and persistence of disease. Reintroduction of disease from wildlife may also be an important factor when analysing persistent breakdowns. There are cases where there is an observable pattern of cattle becoming infected with TB after periods of grazing fields with known badger activity.

² TB Advisory Service - <http://www.tbas.org.uk/>

³ ibTB database - <https://www.ibtb.co.uk/>

County summary

Warwickshire's High Risk Area was incorporated into the Edge Area in January 2018. Previous epidemiology reports for Warwickshire only covered the original Edge Area when the county was split between High Risk Area and Edge Area. Therefore simple comparison of some of the data for the purpose of this report can be difficult. The infection of local wildlife and movement of infected cattle are key contributors to the establishment of endemic disease in this part of the country. Warwickshire will not be a candidate for achieving OTF status in the near future, the main challenge being wildlife as a suspected disease reservoir and difficulties in preventing and controlling disease within badger and deer populations.

Summary of the risk to the Low Risk Area (LRA) and any mitigating factors

Warwickshire is not contiguous to any of the LRA counties and therefore it does not pose a direct risk through infection spread.

As mentioned before, a large and busy M40 motorway can serve to some degree as a physical barrier for wildlife migration and could mitigate the risk of the disease spread northwards. There is a large fallow deer population in certain areas bordering The Edge Area county of Northamptonshire. There were two TB breakdowns in this area in 2018 possibly attributed to wildlife. This can put the neighbouring county of Northamptonshire at a disease risk.

Rugby Cattle market is large, centrally located and well communicated which are factors that can increase the risk of disease spread from cattle sourced within endemic areas being moved to other less endemic areas, including counties within the LRA.

Summary of the risk to the Edge Area from the High Risk Area (HRA)

Warwickshire borders the High Risk Areas of Gloucestershire, Staffordshire, West Midlands and Worcestershire. The incidence of the disease is higher in the south-west part of Warwickshire neighbouring the HRA counties and the infection spread is evident. Apart from the holdings at the very border of the county being exposed to the same wildlife reservoir as the HRA holdings, movements of cattle from these HRA counties is not uncommon.

Summary of the risk to Warwickshire from the adjacent Edge Area counties

Although adjacent counties of Northamptonshire and Oxfordshire have a lower or similar TB incidence rate they do pose a disease risk to the county of Warwickshire. This is because pockets of suspected endemicity in the areas of Northamptonshire and Oxfordshire are very close to the border with Warwickshire. Despite the higher cattle density along the border between Leicestershire and Warwickshire, the number of incidents in the area appears to have decreased. The presence of a small number of cases with likely wildlife origin but showing different genotypes is a reminder of the risk from other nearby endemic areas.

Assessment of effectiveness of controls and forward look

With the current changes in TB testing policies in Warwickshire (increasing the frequency of routine testing from twelve to six months) it is unlikely that incidence will drop within the next two years. Enhancement of cattle related measures (extending compulsory interferon gamma testing to the whole county, severe interpretation of at least the first two tests for OTFW as well as OTFS breakdowns) will improve the detection of TB infected cattle and reduce lateral spread of TB between these animals. Whilst the most likely source of TB infection are badgers, other measures are still required to address the sources and pathways of infection to prevent recurrence of new infection once testing and slaughter

have removed disease. The potential for achieving OTF status by 2025 is compromised by the impact of the suspected level of endemicity in wildlife and the difficulties associated with controlling this risk factor. Also the lack of systematic surveillance of wildlife species (badgers and other species) reduces the ability of APHA to identify and quantify the exact risk posed by these species and to direct effective control measures at these risk factors.

APPENDICES

Appendix 1: Overview of risk and surveillance areas of England and Edge Area objectives and controls

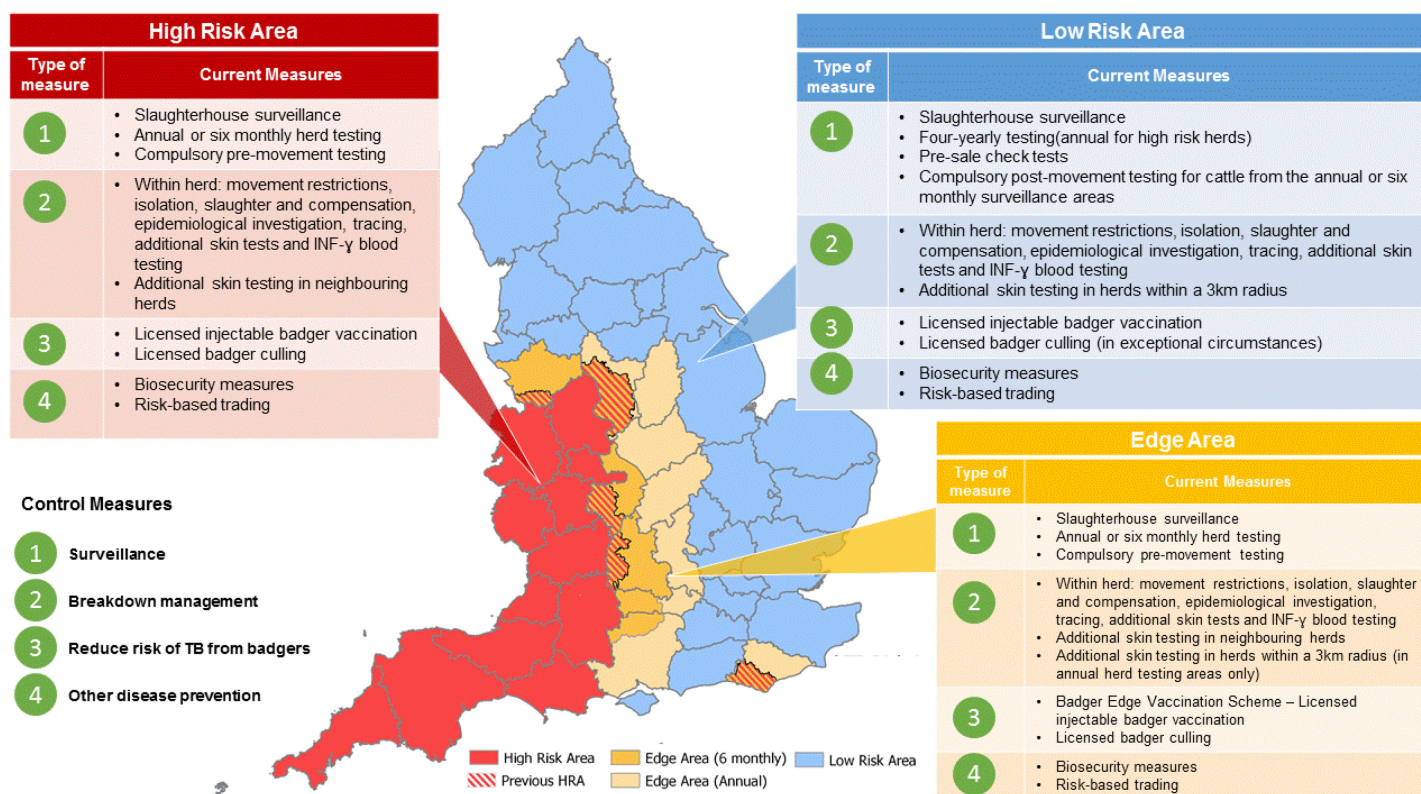


Figure A1: Bovine TB risk and surveillance areas of England effective since January 2018, as set out in the Government's Strategy for Achieving Officially Tuberculosis-Free Status for England⁴.

1.1 Policy objectives for the Edge Area:

Short to medium term:

- slow down geographic spread
- maintain crude herd incidence of OTFW breakdowns <2% overall by 2019
- begin to reduce the incidence rate

Longer term:

- reduce geographic spread of TB and push the Edge Area boundaries westward
- reduce OTFW herd incidence to <1% by 2025
- attain OTF status (crude incidence of indigenous OTFW herd breakdowns <0.1%) for the lowest incidence counties in the Edge Area.

1.2 Key Control Measures

Surveillance:

- six monthly or annual routine herd testing
- additional targeted surveillance of cattle herds located within a 3km radius of new OTFW breakdowns in annual testing sections of the Edge Area (radial testing)
- slaughterhouse surveillance

⁴ <http://www.tbhub.co.uk/wp-content/uploads/2017/09/infographic-TB-measures.pdf>

Management of cases ('breakdowns'):

- increased sensitivity of breakdown herd testing:
 - all breakdown herds must pass two consecutive short interval skin tests at severe interpretation to regain OTF status, irrespective of post-mortem and bacteriological findings
 - mandatory IFN-gamma parallel testing of herds with OTFW breakdowns
 - enhanced management of herds with persistent breakdowns
- enhanced epidemiological investigation and data analysis
- information sharing - location of breakdown herds publicly available (via ibTB interactive mapping tool)⁵

TB controls in the wildlife reservoir (badgers):

- licensed badger culling in high incidence sections of the Edge Area
- government grants for licensed voluntary badger vaccination projects using injectable badger BCG (Badger Edge Vaccination Scheme - BEVS)

Other measures:

- compulsory pre-movement skin testing of cattle moved between herds
- promotion of herd biosecurity measures to reduce the risk of new breakdowns

⁵ ibTB interactive mapping tool - <https://ibtb.co.uk/>

Appendix 2: Cattle industry in the Edge Area of the region

Number of cattle premises by size band in the Edge Area of the region at 1 January 2018

(RADAR data)

Cattle per premises	1-50	51-100	101-200	201-350	351-500	501+	All	Mean	Median
Number of premises	269	94	104	63	13	16	564	109.578	56.5

Finishing units registered in Warwickshire:

	Grazing	Non-grazing
Number of Approved Finishing Units (AFUs)	0	14
Number of Pre-movement Testing Exempt Finishing Units (EFUs)	0	0

Cattle/herd purpose:

	Beef		Dairy		Dual purpose		Unknown		Total
	Number	%	Number	%	Number	%	Number	%	Number
Cattle	40910	66.2	18121	29.3	2767	4.5	4	0.0	61802
Holdings	510		155		178		2		

Appendix 3: Summary of the Warwickshire headline cattle TB statistics

Herd-level statistics	2016	2017	2018
Total number of cattle herds live on Sam at the end of the reporting period	649	647	625
Total number of herd tests carried out in the period	758	726	962
Total number of OTF cattle herds TB tested during the period for any reason	543	519	513
Total number of OTF cattle herds at the end of the report period (i.e. herds not under any type of TB02 restrictions)	596	558	530
Total number of cattle herds that were not under restrictions due to an ongoing TB breakdown at the end of the report period.	614	580	555
Total number of new TB breakdowns detected in cattle herds during the report period	60	84	80
OTF status suspended (OTFS)	15	25	28
OTF status withdrawn (OTFW)	45	59	52
Of the OTFW herd breakdowns:			
How many can be considered the result of movement, purchase or contact from/with an existing breakdown based on current evidence?	2 (Edge only)	0 (Edge only)	3 (Full county)
New OTFW breakdowns triggered by skin test reactors or 2xIRs at routine herd tests	7 (Edge only)	5 (Edge only)	31
New OTFW breakdowns triggered by skin test reactors or 2xIRs at other TB test types (forward and back-tracings, contiguous, check tests, etc.)	7 (Edge only)	7 (Edge only)	16
New OTFW breakdowns first detected through routine slaughterhouse TB surveillance	6	9	5
Number of new breakdowns revealed by enhanced TB surveillance (radial testing) conducted around those OTFW herds (may not be applicable to every county in the Edge Area)	N/A	N/A	N/A
OTFS	N/A	N/A	N/A
OTFW	N/A	N/A	N/A
Number of OTFW herds still open at the end of the period (including any ongoing OTFW breakdowns that began in a previous quarter)	31	45	44
New confirmed (positive <i>M. bovis</i> culture) incidents in non-bovine species detected during the report period (indicate host species involved)	0	0	0

Animal-level statistics (cattle)	2016	2017	2018
Total number of cattle tested in the period (animal tests)	95240	88981	119906
Reactors detected:			
Tuberculin skin test	310	284	426
Additional IFN-gamma blood test reactors (skin-test negative or IR animals)	82	109	332
Reactors per breakdown	6.5	4.7	9.5
Reactors per 1000 animal tests	4.1	4.4	6.3
Additional animals identified for slaughter for TB control reasons (DCs, including any first-time IRs)	10	4	8
SLH cases (tuberculous carcasses) reported by FSA	8	17	14
SLH cases confirmed by culture of <i>M. bovis</i>	7	13	8
Private slaughter	0	5	10

Appendix 4: Suspected sources of *M. bovis* infection for all the new OTFW and OTFS breakdowns identified in the report period

Source of infection	Possible	Likely	Most likely	Definite	Weighted contribution
Badgers	19	21	24	1	60.2%
Cattle movements	11	4	3	0	12.5%
Contiguous	3	2	0	0	1.8%
Residual Infection	3	5	3	0	8.5%
Domestic Animals	0	0	0	0	0.0%
Non-specific Reactor	0	0	0	0	0.0%
Fomite source	4	1	0	0	3.1%
Other wildlife	9	3	4	0	12.5%
Other or Unknown Source	0	0	1	0	1.3%

Appendix 5: Overview of the TB Control Programme in Warwickshire

Summary of TB control measures specific to Warwickshire:

5.1 Edge Area Testing Policy

- In January 2018 six monthly routine surveillance herd testing (instead of twelve monthly) was introduced across the whole county.
- No discretionary measures applied in OTFS breakdowns.
- Enhanced case management measures were applied to one persistent breakdown in 2018 (additional interferon gamma testing and biosecurity advice).

5.2 Unusual TB breakdowns

- One important factor contributing to the persistence of one breakdown was unresolved cattle identification issues and farm record deficiencies which prevented APHA from lifting restrictions for a prolonged period of time.
- Another factor contributing to the persistence of another breakdown was the distribution of the herd over numerous locations. Every herd test was completed in seven or eight parts taking an unusual length of time to complete each test and resulting in prolonged restrictions.

5.3 Other Testing Measures

- Occasionally testing becomes overdue but is usually resolved within 60 days of the test becoming overdue. There is no evidence of those delayed tests having had any notable impact on the epidemiology of TB in Warwickshire.

5.4 Other Control Measures

- Found dead badger survey completed but results are pending publication.
- Licenced badger vaccination carried out privately by the Warwickshire Badger Group.
- TB Advisory Service is providing farmers with free biosecurity advice (nine visits carried out in 2018)