Animal Health and Veterinary Laboratories Agency

Bovine tuberculosis:

Infection status in cattle

Extract of the executive summary and figures

From the annual surveillance report

For the period

January to December 2010

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List of figures (in order of appearance in the report)

EXECUTIVE SUMMARY

New bovine TB incidents in Great Britain

- There were 1737 **OTF-S** incidents and 2947 **OTF-W** incidents in 2010. The reduction in the numbers of total, OTF-W and OTF-S incidents observed in 2009 was not maintained in 2010. **Overall, the total number of new incidents in Great Britain (GB) increased non-significantly by nearly 3% in 2010 relative to 2009 (p=0.20)**. The number of OTF-W incidents also increased non-significantly by 5% (p=0.06), but there was virtually no change in the number of OTF-S breakdowns (1,753 in 2009; 1,737 in 2010).

- **Since 2002 the rate of increase of OTF-W new incidents has fallen by approximately one third compared with 1986-2000**: in the period Jan 2003-Dec 2010, OTF-W new incidents doubled every 9.3 years and the annual rate of increase was 7.8% (Figure A1).

- Of the 4686 total incidents disclosed in GB in 2010, 2947 (62.9%) were OTF-W; a similar proportion as in 2009 (61.5%) (p=0.17) (Figure A2). Two incidents in 2010 were unclassified.

- There was a **small non-significant increase in OTF-W new incidents per 100 live herds** in 2010 relative to 2009 (p=0.2). This reflected both increasing absolute numbers of incidents and a 2% reduction in the number of live herds.

- **However, the herd incidence expressed as OTF-W breakdowns in *herds tested* (p=0.3) or *unrestricted herds* tested (p=0.2) actually decreased non-significantly by around 5% between 2009 and 2010**. So, although the number of OTF-W incidents increased in 2010, both denominators were larger (i.e. more herds were tested) in 2010 compared with 2009.

- The number of OTF-S breakdowns per 100 herds was virtually unchanged (-0.8%) but a 7.7% increase in the number of herds tested in 2010 resulted in an 8.0% reduction in the number of OTF-S breakdowns per 100 herds tested (p=0.012) and an 8.8% reduction in the number of OTF-S breakdowns per 100 unrestricted herds tested (p=0.006) between 2009 and 2010.

- Overall, OTF-W breakdowns were 18 days shorter in 2010 (median 220 days; interquartile range 156 to 375) than in 2009 (238; 161 to 392) (p<0.001) (Figure C2). OTF-S incidents were 16 days shorter in 2010 than in 2009 (p<0.001).

- **In 2010, 349 (7.5%) of total new incidents and 196 (6.7%) of OTF-W new incidents were disclosed through pre-movement testing (PrMT)**. This was no different to the percentage of total incidents (7.8%, p=0.51) and of OTF-W incidents (7.6%, p=0.18) identified by PrMT in 2009.

- In spite of an increase in the number of herds tested and no statistically significant change in the incidence of OTF-W breakdowns in tested herds, the **proportion of OTF-W new incidents disclosed in the slaughterhouse increased significantly from 17% in 2009 to 22% in 2010 (p<0.001).** This is the highest annual contribution made by slaughterhouse surveillance since 2001.

- The number of samples from slaughterhouse cases examined by AHVLA increased by more than one third, and the number yielding *M. bovis* increased by almost 50% between 2009 and 2010. These observations suggest either that the sensitivity of culture was increasing or the selection of suspect samples by meat inspectors was more accurate in 2010 than in 2009.

- The proportion of GB herds under restriction at the middle of each month has been falling in 2010. On average 3.9% of live GB herds were under restriction in 2010 as a result of a TB incident of any type, but this reduced to 3.1% if only OTF-W incidents were considered (Figure C1).

Variation between Reporting Regions[4]

- The regional distribution of all new incidents differed between 2009 and 2010 (χ^2=25.0, 4df P<0.001). The East and North regions of England sustained almost 20% more new breakdowns in 2010 than in 2009, but the number of new breakdowns in Wales and Scotland fell in 2010 by 13% and 8% respectively.

- The reductions observed in total and OTF-W incidence in 2009 were mainly a result of decreases of up to 15% in the number of incidents recorded in the West Region. By contrast, in 2010 there was a non-significant 5% increase in the number of total incidents recorded in the West region, from 2441 in 2009 to 2550 in 2010.

- The number of OTF-W breakdowns increased in the East (116 in 2009 to 154 in 2010), North (435 to 514) and the West (1693 to 1773), but decreased in Wales (549 to 494). There was virtually no change in the number of OTF-W breakdowns identified in Scotland (11 to 12).

- There was significant variation across regions in 2010 compared to 2009 in relation to OTF-S breakdowns (χ^2=12.0, 4df, p=0.02). The number of OTF-S breakdowns increased in the East (149 in 2009 to 162 in 2010), North (189 in 2009 to 226 in 2010) and to a lesser extent in the West but decreased in Wales (634 in 2009 to 541 in 2010).

- The proportion of incidents that were OTF-W varied significantly across regions (χ^2=215.3, 4 d.f., p<0.001). Less than 50% of incidents were OTF-W in Wales and the East region compared with nearly 70% in the North and West of England. Only 27% of all incidents were OTF-W in Scotland, but there are far fewer incidents in this region. There were no differences in the proportion of OTF-W incidents within regions between 2009 and 2010 (P>0.05).

- The number of OTF-W incidents **per 100 live herds** rose in all regions except Wales, where it fell by 7%. After the small decrease in OTF-W incidence observed in Wales in 2009, OTF-W incidence has continued to fall in Wales and is now below 4% of all cattle herds (Figure B5). Despite an observed decrease reported in 2009, OTF-W incidence increased to almost 9% of all live herds in the West region of England in 2010, almost returning to its peak in 2008 (Figure B5).

- Once the number of herds tested is taken into account, the changes in the number of OTF-W incidents **per 100 tested herds** between 2009 and 2010 are less severe (Figure B6). Increases in incidence in the East and North of England were 9.9% and 3.7% respectively and there was very little change in the number of OTF-W incidents

[4] For details of Animal Health Offices and counties in each reporting region, see the appendix.

per 100 tested herds in the West region. Nevertheless the almost 12% reduction in incidence in Wales was similar to the reduction in incidence based on the number of active herds as 91% of herds in Wales were tested in 2010.

- In the North region the number of OTF-W new incidents per 100 *tested* herds has now overtaken that of Wales and appears to be rising more steeply than the trend using all herds as a denominator would suggest.

- Clear **reductions** (greater than 20%) in the number of OTF-W new incidents between 2009 and 2010 were observed in Dyfed, Gwent, Gwynedd and Clywd in Wales, and Cornwall and Warwickshire in England.

- Substantial **increases** in the number of OTF-W new incidents between 2009 and 2010 were observed in Shropshire (22%), Derbyshire (27%), Hereford & Worcestershire (28%), Oxfordshire (+31%), Somerset (+43%), Dorset (+55%), Lancashire (40%), Leicestershire (+75%), Cheshire (97%) and Hampshire (+120%) in England and West Glamorgan (83%) in Wales. Note - the increases in Hampshire, Lancashire and Leicestershire were from very low numbers the previous year.

- The **duration of OTF-W breakdowns** that ended in 2010 varied by region ($F=15.2$, $P<0.001$). OTF-W breakdowns in Wales were significantly longer than in the East and North Regions of England ($p<0.001$) (Figure C3). On average, more reactors were removed from OTF-W breakdowns in Wales that closed in 2010, thus possibly prolonging the breakdowns.

Variation between parish testing intervals (PTI)

- For the first time in many years, the majority of herds are not within 4-yearly tested parishes. The proportion of herds on yearly testing increased sharply in 2010, from 32.2% in 2009 to 46.2% in 2010. This was matched by a corresponding drop in the proportion of herds undergoing two and four yearly testing. The proportion of herds in two yearly tested halved, from 12.4% in 2009 to 6.6% in 2010 (Figure E2). These changes reflect radical changes in the distribution of PTIs that were implemented in England at the beginning of 2010. All of Scotland remained on 4-yearly routine herd testing and all herds in Wales remained on annual whole herd testing.

- In yearly tested parishes the proportion of OTF-W incidents triggered by TB slaughterhouse cases increased from 16% to 21% ($p<0.001$) and there was also an increase from 31% in 2009 to 45% in 2010 in four yearly tested parishes that approached significance ($p<0.06$).

- **A significantly larger proportion of OTF-W new incidents occurred in yearly-tested parishes in 2010 than in 2009 (95% vs. 89%)**, but there were also proportionately more herds tested in yearly tested parishes in 2010 than in 2009 (50% of all herds tested vs 68% in 2010) (Figure E3). The number of new OTF-W incidents increased in yearly tested parishes between 2009 and 2010, but decreased in all other testing intervals. Only 2.7% of all new OTF-W incidents in 2010 occurred in 3- or 4-yearly testing areas.

- Despite an overall non-significant increase in OTF-W incidents detected, the number of OTF-W new incidents per 100 live herds demonstrated small declines between 2009 and 2010 in all parish testing intervals. This is a result of more herds in yearly tested parishes (higher denominator), despite the increase in the absolute numbers of

incidents, and fewer incidents in the other testing intervals (lower numerator). OTF-W incidence in yearly tested parishes fell to 7.2% in 2010 as more, possibly lower risk, herds were moved to annual testing. There was a sharp fall in incidence in two-yearly tested parishes in 2010, most probably a result of the removal of high risk herds from this testing interval into yearly testing and consistent adoption of 2-yearly testing for all herds in the 'buffer zone' adjoining the core annual testing area.

- In 2010 PrMT identified 6.8% (189/2787) of new OTF-W incidents and 7.7% (329/4283) of total incidents in yearly tested parishes, compared with 8.6% (7/81) of OTF-W new incidents and 10.8% (20/185) of total incidents identified in two yearly parishes. The number of incidents identified by PrMT in yearly tested parishes increased by 12% between 2009 and 2010, but there was a sharp reduction of 68% in the number identified by PrMT in two yearly tested parishes, again reflecting the movement of more risky herds to annual testing in 2010. While the numbers of incidents across parish testing intervals changed, the proportion of total new incidents identified in yearly parishes was identical in 2009 and 2010 (7.7%) and in two yearly parishes the proportion of incidents identified by PrMT in 2010 (10.8%) remained similar to 2009 (13.4%) (p=0.43).

Variation between different herd sizes

- As in previous years, OTF-W new incidents per 100 live herds increased with mean herd size even after adjusting for the effects of herd type and PTI. OTF-W incidence ranged from 1.4% in herds of between 1 to 50 animals to 12.4% in herds with more than 450 animals.
- The mean duration of OTF-W incidents increased with increasing herd size, from 235 days in herds with fewer than 50 animals to 497 days in herds with more than 450 animals.

Variation between different herd types

- After adjusting for herd size and PTI, the number of OTF-W new incidents per 100 *Dairy* herds was no larger than in *Beef* herds. However, the number of OTF-S incidents per 100 dairy herds was almost twice as high as that in beef once adjusted for herd size and PTI.

- In a major departure from previous years, there was no difference in the proportion of OTF-W incidents detected in the slaughterhouse across the herd types (p=0.13). Incidents in Beef herds were statistically no more likely to be detected in the slaughterhouse than incidents in Dairy herds.

- The proportion of OTF-W incidents detected in the slaughterhouse in Dairy herds significantly increased from 14% in 2009 to 20% in 2010 (p<0.001). The proportion of slaughterhouse cases in Beef herds also increased, from 19% to 24% (p=0.002) but there was no change in the proportion of Other herds that were detected in the slaughterhouse.

Molecular epidemiology of M. bovis (project SB4020)

- There are 4578 isolates in the spoligotype database labelled '2010' by Year (2009 = 5306). This reduction reflects the implementation by AHVLA of a policy of one genotyped isolate per new TB breakdown from September 2010.
- Of the 2947 cattle breakdowns in 2010, we obtained full genotype data for 97% of the breakdowns (96.7% 2009, 96.6% 2008). Between January and August 2010 an average of 1.6 isolates per CPH were genotyped (2009, 1.7 isolates per CPH). In the final 4 months of 2010, after implementation of 'one isolate per breakdown' 1.1 isolates per CPH were genotyped on average. There is no evidence for any genotype rising rapidly in frequency in bovine samples.
- The 4578 isolates recorded for 2010 include 175 isolates from animals other than cattle (242 in 2009). 151 of those isolates were *M. bovis* and 24 isolates were *M. microti*. The 151 *M. bovis* isolates represent 99 separate TB incidents in non-bovine species. The genotypes found in non-bovines reflect those found locally in cattle and are typically *M. bovis*. The exception is feline samples in which, as seen in previous years, *M. microti* isolates are common.
- The increasing frequency of breakdowns in swine and sheep is highlighted. Breakdowns in these species are of many different genotypes, most of which are commonly found in cattle. Furthermore, the majority of breakdowns in pig and sheep holdings were caused by genotypes of *M. bovis* within the relevant home range for cattle genotypes. These data suggest that the increase in ovine and swine *M. bovis* isolates is reflecting the disease in cattle herds, either by spill over from cattle or by infection from a common local source.

TERMINOLOGY

- Inconclusive reactors (IRs) reported as such, and slaughterhouse cases, are not counted as reactors to the skin test. Hence 2xIRs and 3xIRs compulsorily slaughtered by AHVLA do not contribute to reactor totals in this report. In some figures there is a reference to incidents with no reactors, either at the start of the incident or at any time during it. Such incidents include those in which only IRs are taken and those initiated by culture-positive slaughterhouse cases where no reactors were found in subsequent check tests.

- Parish Testing Interval (PTI) in the report refers to the PTI at the date of the test or disclosing test, as appropriate. Otherwise, PTI is that at the end of the first quarter for the year in question if not related to a test or incident. In all cases, PTI is the interval for the parish in which a herd resides according to its CPH. Specific herd testing intervals imposed on higher risk herds are not taken into account in this report.

Classification of bovine TB incidents (breakdowns)

- Since January 2011, cattle herds are being described by their Official Tuberculosis Free (OTF) status. This can be OTF-W (OTF withdrawn), OTF-S (OTF suspended), or if free from any TB-related movement restrictions, OTF. For consistency we have adopted the same terminology in this report.

- In general, OTF-W corresponds to the previous 'CNI' (confirmed new incidents), i.e. those herds suffering a new TB breakdown in which post mortem evidence of *M. bovis* infection is found in at least one reactor. However, in Wales and Scotland since January 2011 a small proportion of reactor herds without post mortem evidence of infection can also be designated OTF-W, but for the purposes of the analyses in this report such breakdowns have been treated as OTF-S.

- OTF-S breakdowns describes TB reactor herds without visible lesions or positive culture results. Herds also have their OTF status temporarily suspended when slaughterhouse cases are found and pending a culture result, when restrictions are served due to overdue tests or IRs are found within three years of a previous OTF-W breakdown, but such restrictions do not contribute to OTF-S breakdown totals in this report.

- Where the official OTF status is not available, and incorporating epidemiological risk factors to adjust is not possible, all references to OTF-W incidents within this report are referring to incidents in which there is specific post mortem evidence of bovine TB. This evidence can be either (a) the identification of *M. bovis* in cultured tissue or (b) the presence of visible lesions in the carcass of a reactor to the skin test or the interferon-gamma test.

A. New bovine TB incidents in Great Britain

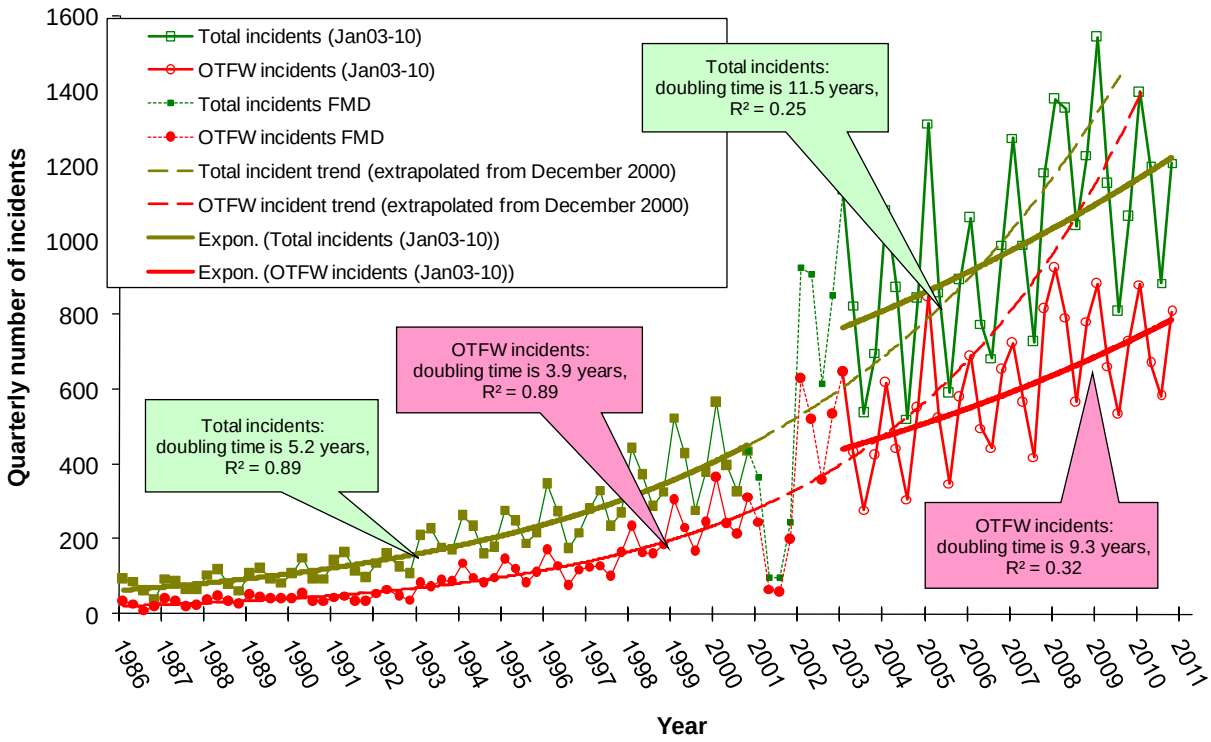

Figure A1: Quarterly numbers of total and OTF-W new bovine TB incidents between January 1986 and December 2010

The slopes of trends in Figure A1 are expressed as doubling times; up to 2000, **OTF-W** new incidents doubled every 3.9 years, equivalent to a year-on-year increase of 19.4%. Since 2002 the rate of increase of OTF-W new incidents has fallen to approximately one third: OTF-W new incidents doubled every 9.3 years and the annual rate of increase was 7.8%. For **total** incidents, the doubling time since 2002 has been longer than for OTF-W incidents, at 11.5 years, the instantaneous rate of increase was equivalent to 6.3% and the annual rate of increase was 6.2%. Up to the FMD outbreak of 2001, the doubling time was 5.2 years, the instantaneous rate of increase was equivalent to 13.3% and the annual rate of increase was 14.5%.

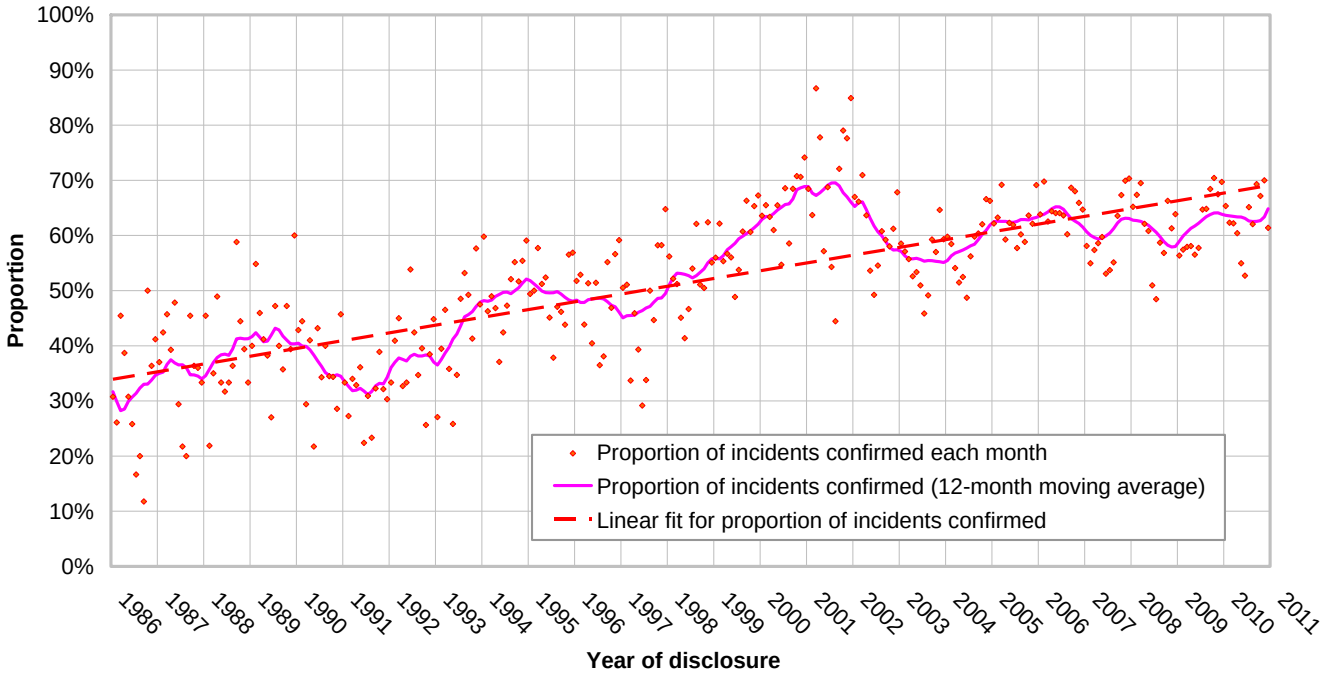

Figure A2: Proportion of new TB incidents that were OTF-W in GB per month from January 1986 to December 2010

The monthly proportion of incidents that were OTF-W in GB between 1986 and 2010 is shown in Figure A2. The proportion has been oscillating around 62% since 2005 and is now very slightly below the trend line. This levelling-off may be a sign that reactors in many incidents are in an early stage of infection, so that lesions are more difficult to detect. The proportion of non-visibly lesioned reactors in which *M. bovis* was detected has, if anything, increased in 2010 (Figure H1).

B. Geographical distribution of new incidents in Great Britain

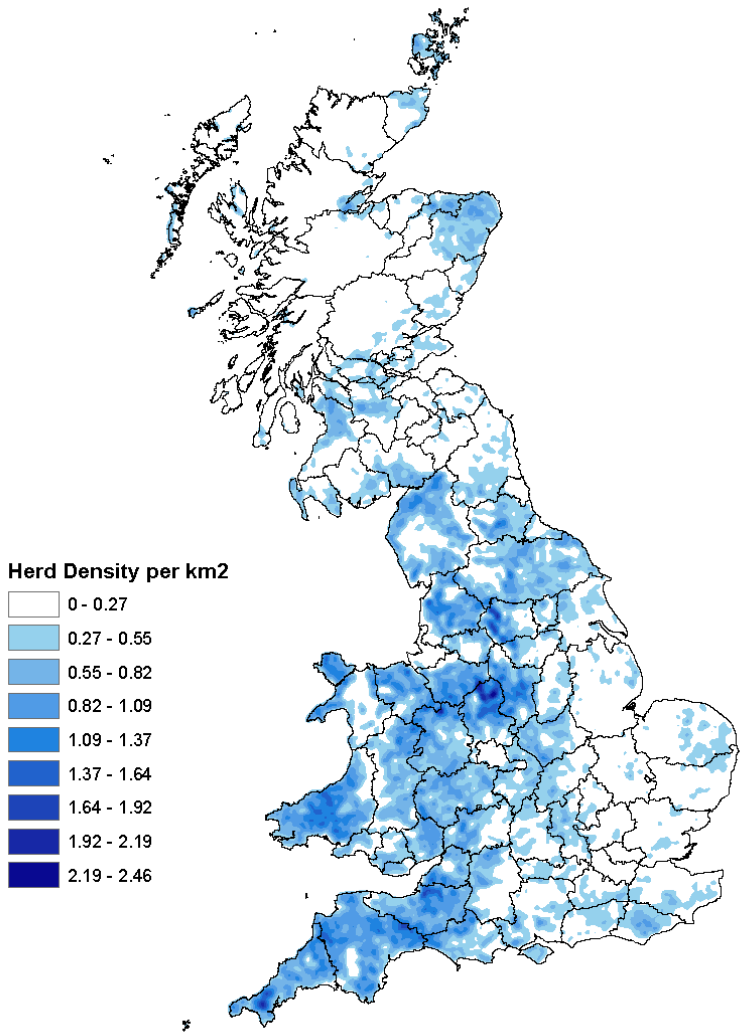

Figure B1: The density of live cattle herds registered on VetNet in 2010

Figure B1 shows wide variation in the number of herds per square km in Great Britain, with large areas having fewer than 0.27 herds per km² and a few areas in which the density is more than eight times greater.

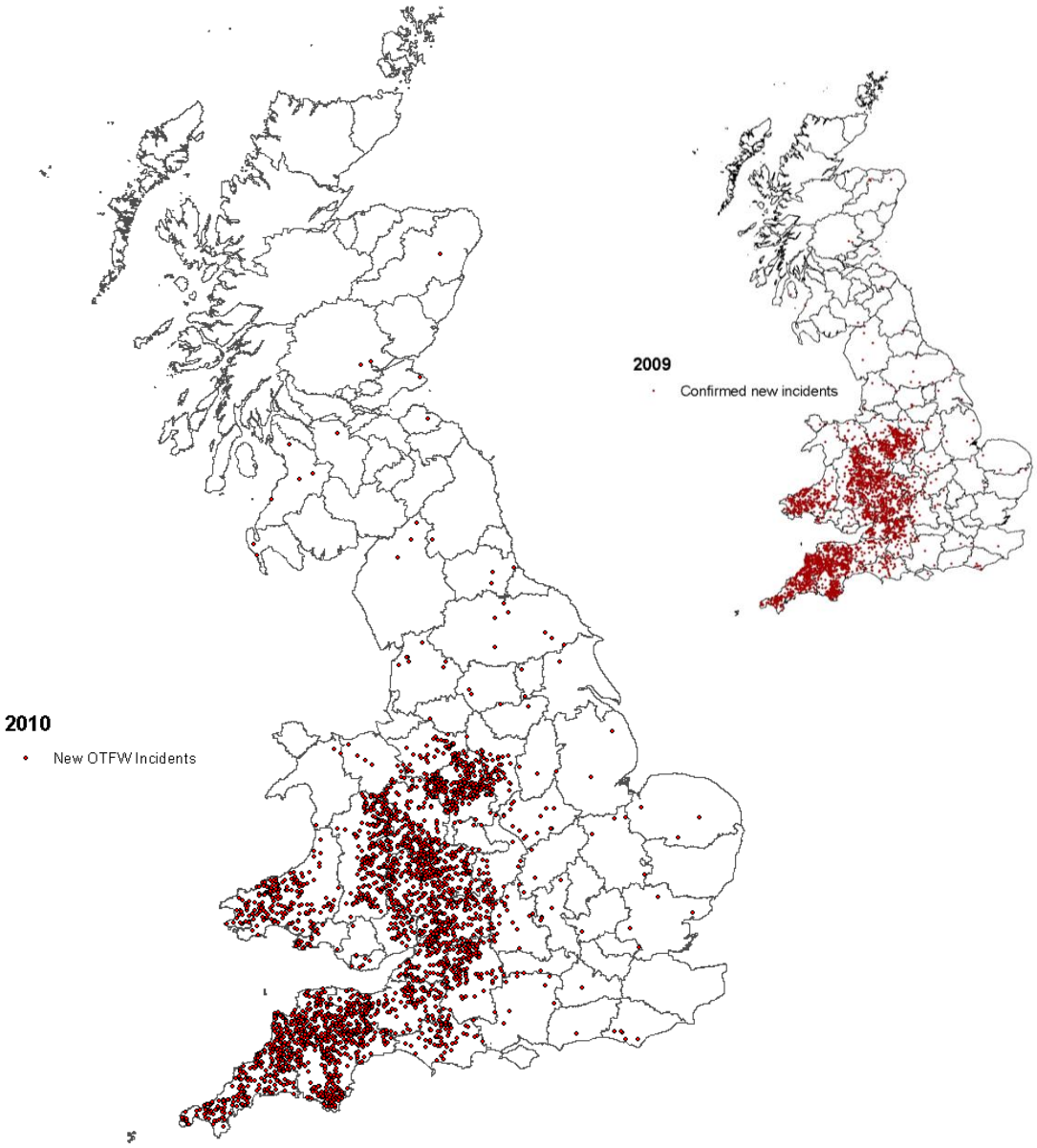

Figure B2: Geographical distribution of OTF-W new bovine TB incidents between January and December 2010, with inset showing the distribution of OTF-W new incidents in 2009

The distribution of OTF-W new incidents in GB is shown in Figure B2. In comparison with 2009 (see inset), further spread of new OTF-W incidents eastwards into Dorset, Hampshire and Oxfordshire, and northwards into Cheshire, Derbyshire and Leicestershire. This may be a reflection of the greater intensity of surveillance in those counties as a result of the PTI review implemented in January 2010. In lower-incidence counties, apparently sporadic OTF-W new incidents continued to be disclosed.

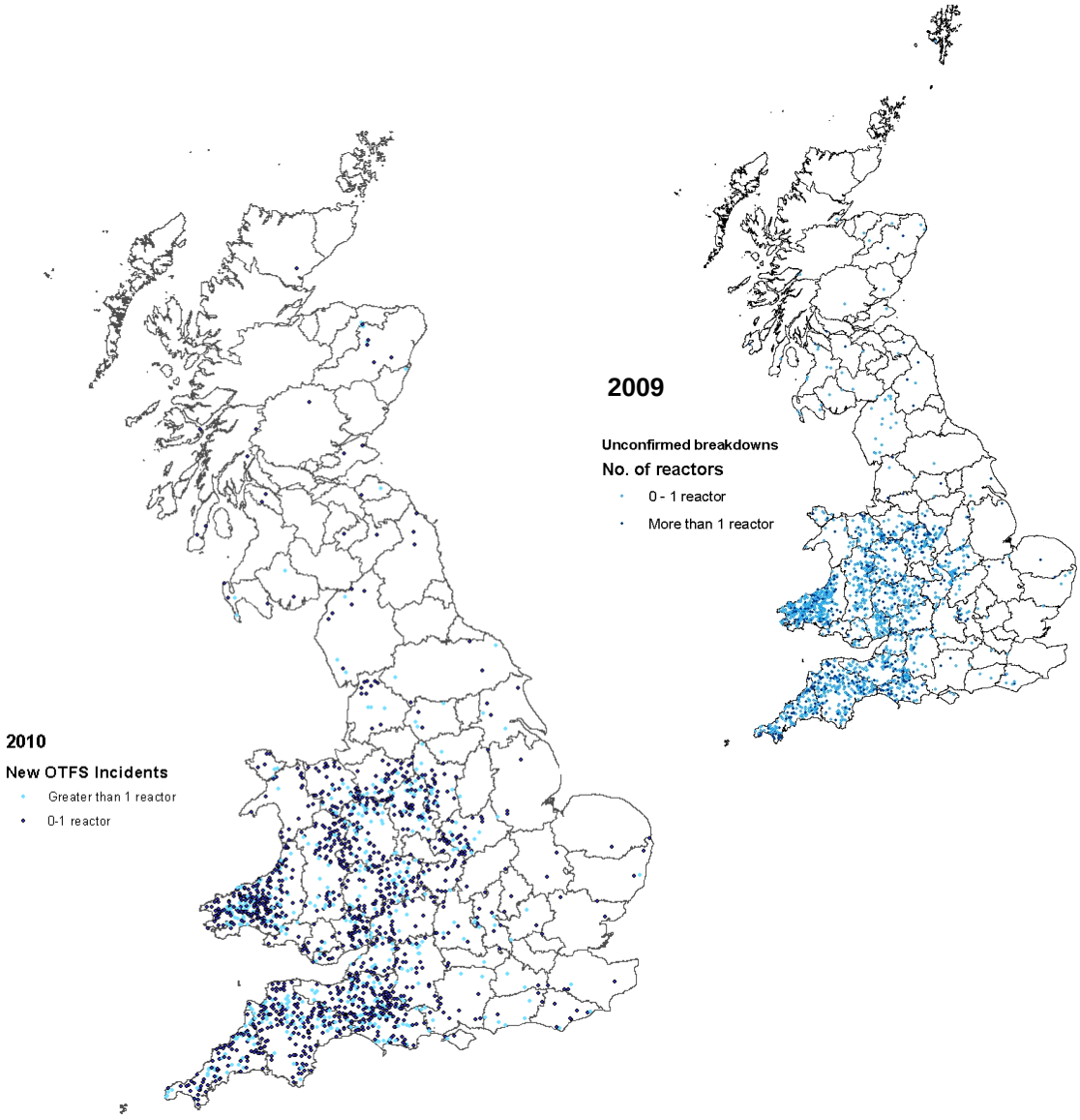

Figure B3: Geographical distribution of OTF-S new bovine TB incidents between January and December 2010, with inset showing the distribution of OTF-S incidents in 2009

OTF-S incidents, figure B3, have been split into two categories; those with zero or one reactor at the time of data download, and those with two or more. There may be an undercounting of multi-reactor incidents that occur towards the end of the year as they have less time to accumulate reactors. Those with two or more reactors tend to be within the endemic areas: the South West and west of England and Dyfed and Powys in Wales. Those with zero or one reactors were relatively more common in the East and North regions and in Scotland.

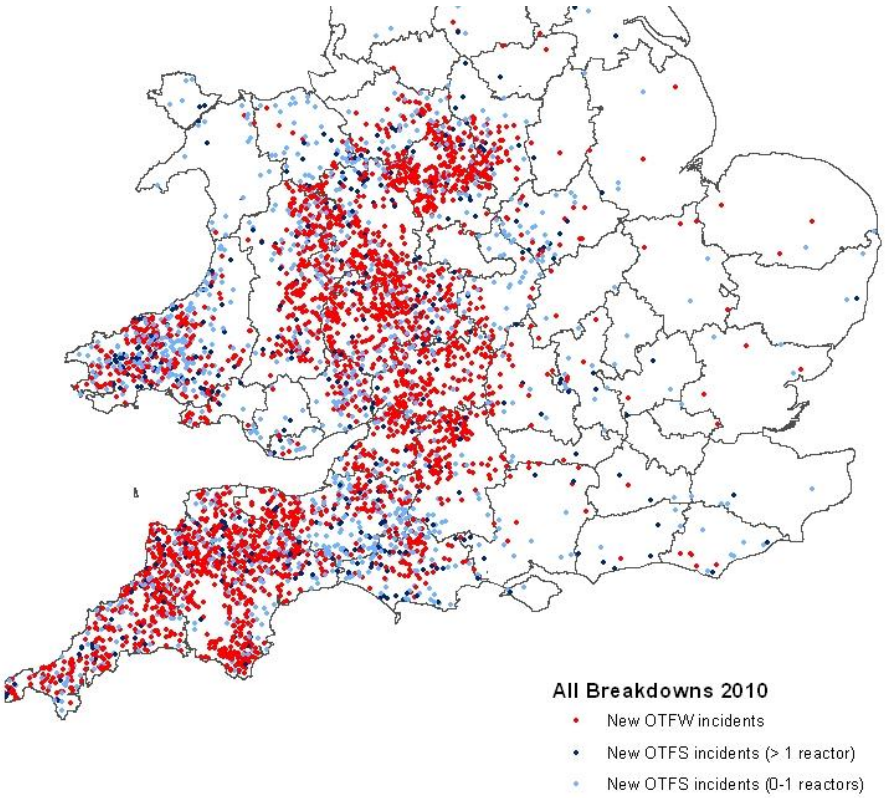

Figure B4: Geographical distribution of OTF-W and OTF-S new bovine TB incidents in 2010: Detail for the southern part of Great Britain

Figure B4 shows all new incidents occurring in West, East and Wales regions. The commonly observed pattern in which OTF-S incidents tend to surround areas with OTF-W incidents was clearly seen around the endemic TB areas. Spread of both OTF-W and OTF-S incidents eastwards and northwards into counties such as Hampshire, Oxfordshire, Clwyd, Dorset, Leicestershire and Cheshire can be seen.

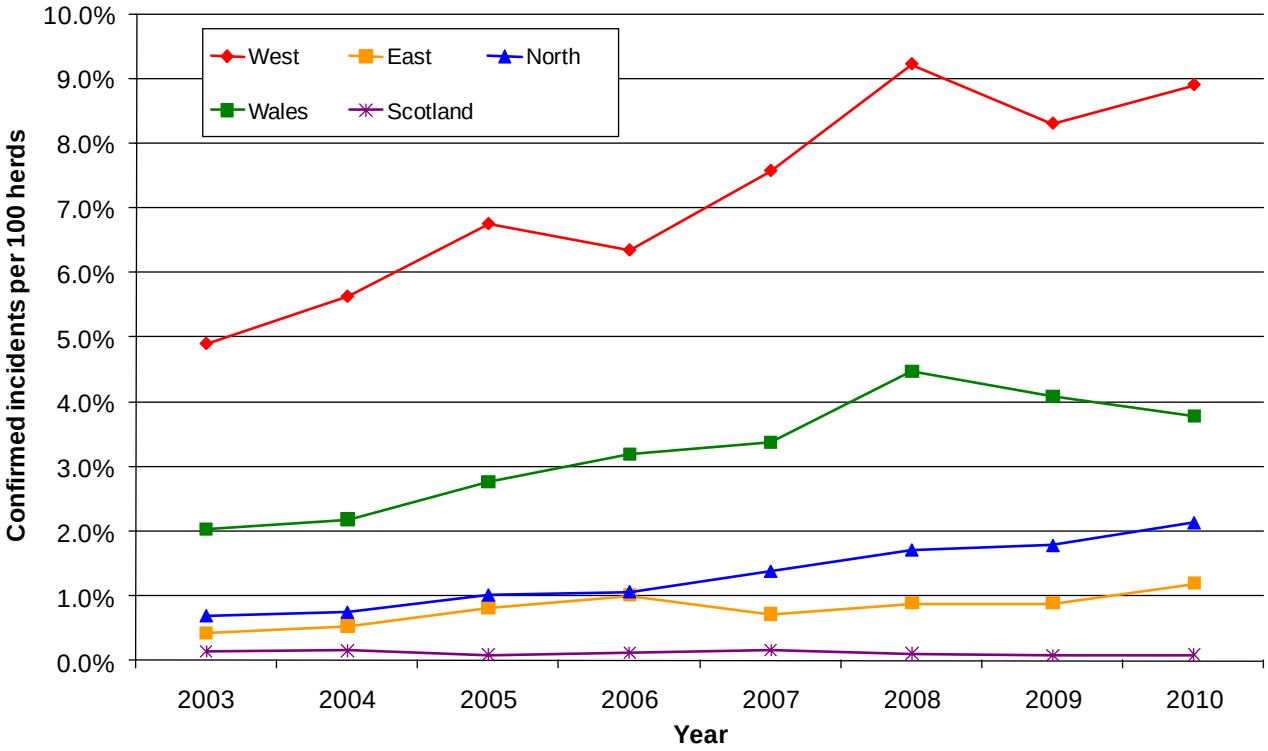

Figure B5: Variation in the number of OTF-W new bovine TB incidents per 100 live herds between 2003 and 2010 by Reporting Region

Despite an observed decrease between 2008 and 2009, OTF-W incidence increased to almost 9% in the West region in 2010, approaching the peak value seen in 2008. In contrast, OTF-W incidence has continued to fall in Wales and is now below 4%. It is too early to say if the benefits of increased testing in Wales are being realised as 2010 was only the second full year of Herd Check Wales, in which all herds were tested yearly irrespective of local incidence. Over a longer period (between 2003 and 2010) the incidence in Scotland has been almost constant and the numbers of incidents remain too low for proportional increases to be of concern. OTF-W incidence in both the East and North Regions has been rising since 2007 and both regions recorded a large increase in OTF-W incidence in 2010.

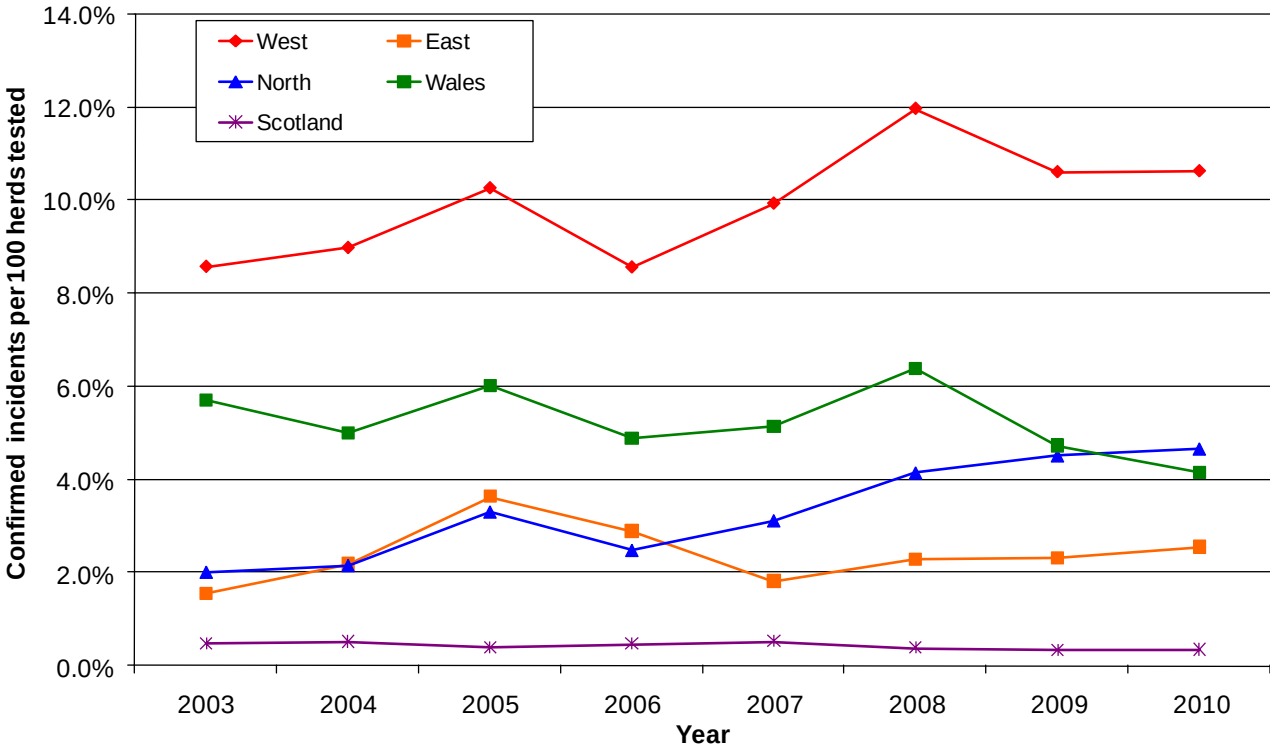

Figure B6: Variation in the number of OTF-W new bovine TB incidents per 100 herds tested between 2003 and 2010, by Reporting Region used in 2010

The shape of the seven-year trend for the number of OTF-W new incidents per 100 herds tested was generally similar to that where the denominator was all live herds, with the exception of the North region. In the North Region the number of OTF-W new incidents per 100 *tested* herds has now overtaken that of Wales and appears to be rising more steeply than the trend using all herds as a denominator would suggest.

In Wales, the number of OTF-W new incidents per 100 *tested herds* fell further between 2009 and 2010, probably as a result of the change to universal annual testing in Health Check Wales. In East region the proportion of herds tested was similar to that of herds in the North region, but the larger increase in number of incidents per 100 herds tested showed a greater increase in the East than in the North between 2009 and 2010.

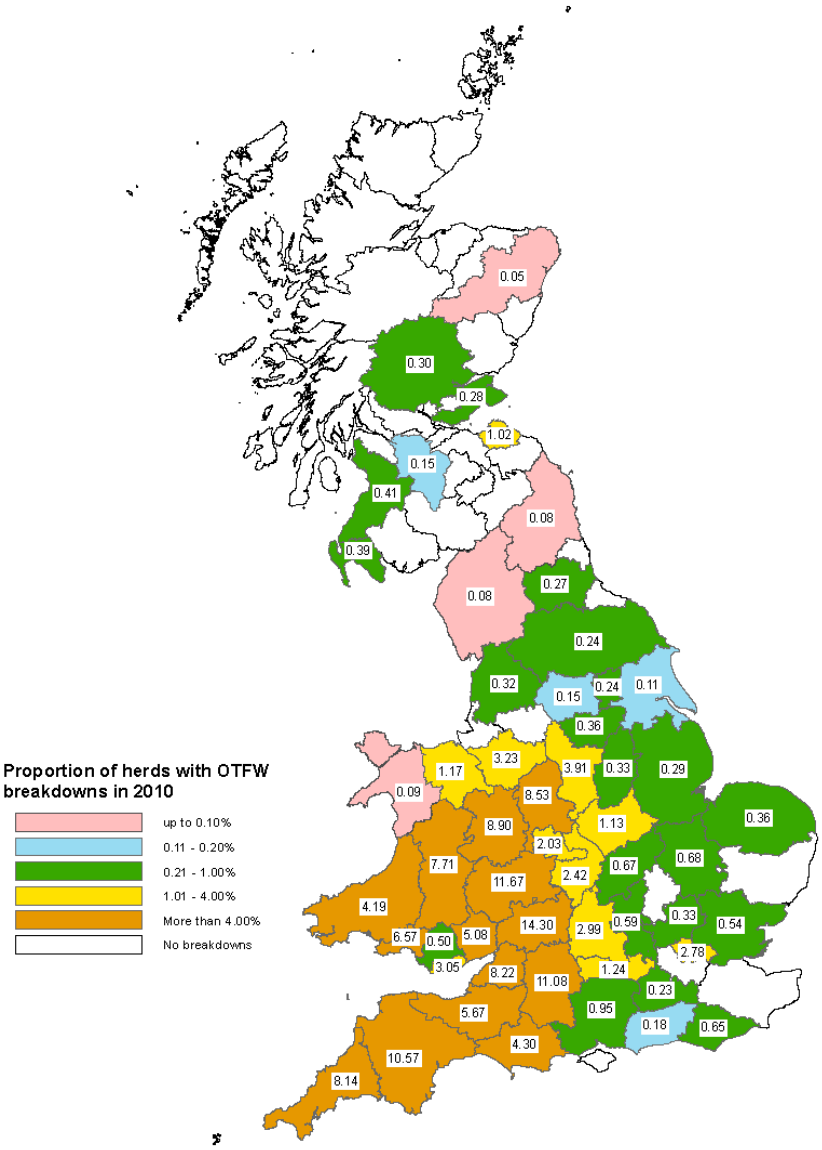

Figure B7: Proportion of live herds with OTF-W bovine TB incidents by county between January and December 2010: Number of OTF-W new incidents per 100 live herds.

In 2009 there were 12 counties with more than 4.0 OTF-W new incidents per 100 live herds. In 2010 this had increased to 14 of which eight were in the West of England, two were in the North of England (Shropshire (8.9%) and Staffordshire (8.5%) and four were in Wales. There was a gradation of number of OTF-W new incidents per 100 live herds between the South-West and the North-East of England and Wales. The band of comparatively lower bTB incidence in the area running between Dorset, Somerset and the southern most part of Wales that has been observed in previous reports is no longer obvious. OTF-W incidence in Dorset and Somerset has once again exceeded 4% despite a fall in OTF-W incidence in both counties in 2009. High proportions of OTF-W breakdowns in Scotland reflect small numbers of herds. For example in East Lothian there was one OTF-W incident in 77 herds.

C. Duration of bovine TB incidents

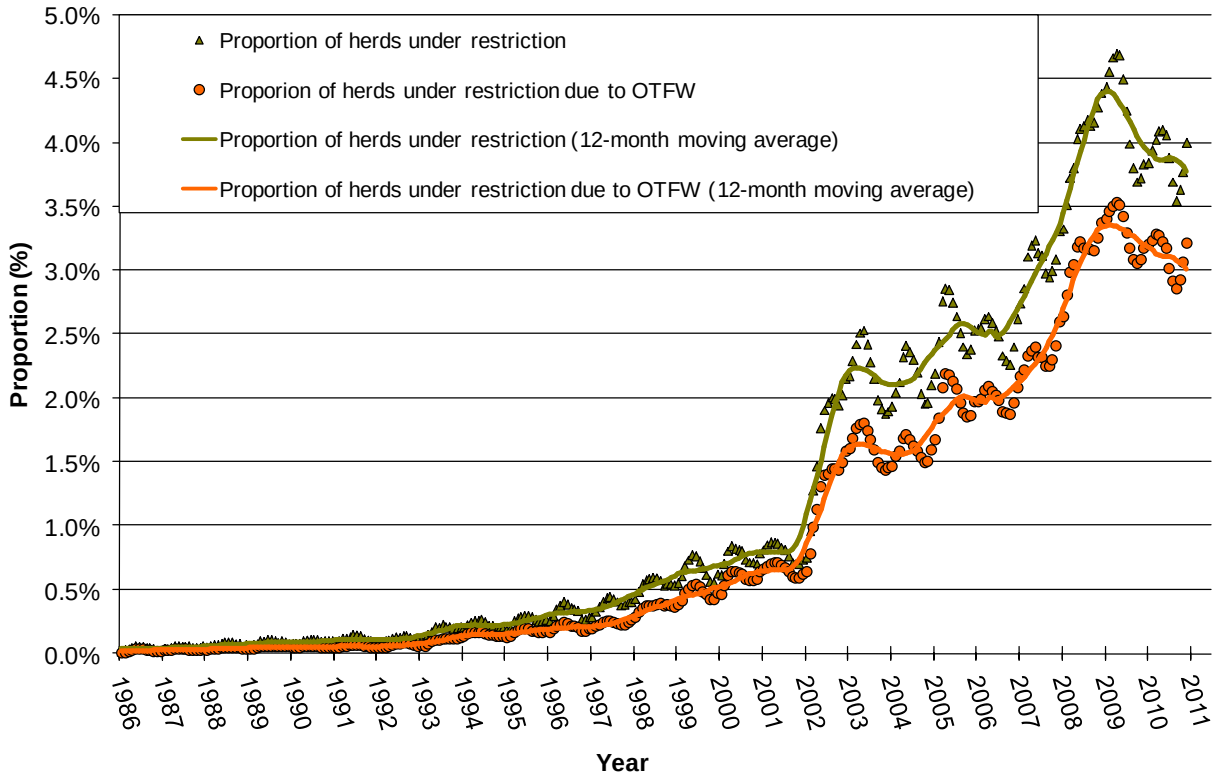

Figure C1: Proportion of live GB herds under TB movement restrictions as a result of a TB breakdown by month between January 1986 and December 2010

The proportion of live GB herds under restriction as a result of a TB breakdown continued to fall in 2010, from its peak early in 2009 for total, OTF-W and OTF-S incidents. On average 3.9% of live herds in GB were under restriction in 2010. For OTF-W incidents, the reduction has also been maintained although it is not as steep as for total incidents. Despite some seasonal fluctuations the moving average has been falling since early 2009. In 2010 the average proportion of live GB herds under restriction for an OTF-W incident was 3.1%.

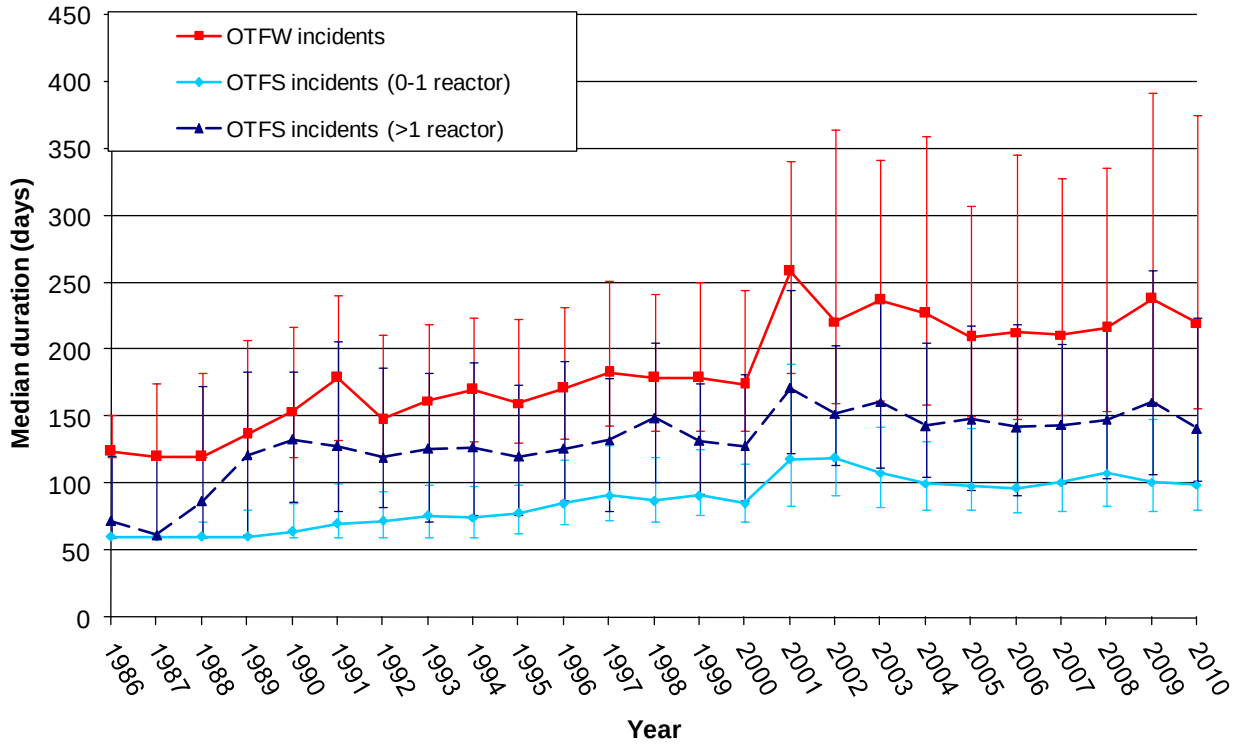

Figure C2: The median duration of OTF-W and OTF-S incidents ending between January 1986 and December 2010, with interquartile ranges.

OTF-W incidents were typically of longer duration than OTF-S incidents every year, and OTF-S incidents with one or fewer reactors tended to be of shorter duration than those with two or more reactors. Overall OTF-W breakdowns were shorter in 2010 (median of 220 days) than in 2009 (median of 238 days). In general, all OTF-S incidents were significantly (16 days) shorter in 2010 than in 2009 and there was a marked decrease in the duration of OTF-S incidents with multiple reactors.

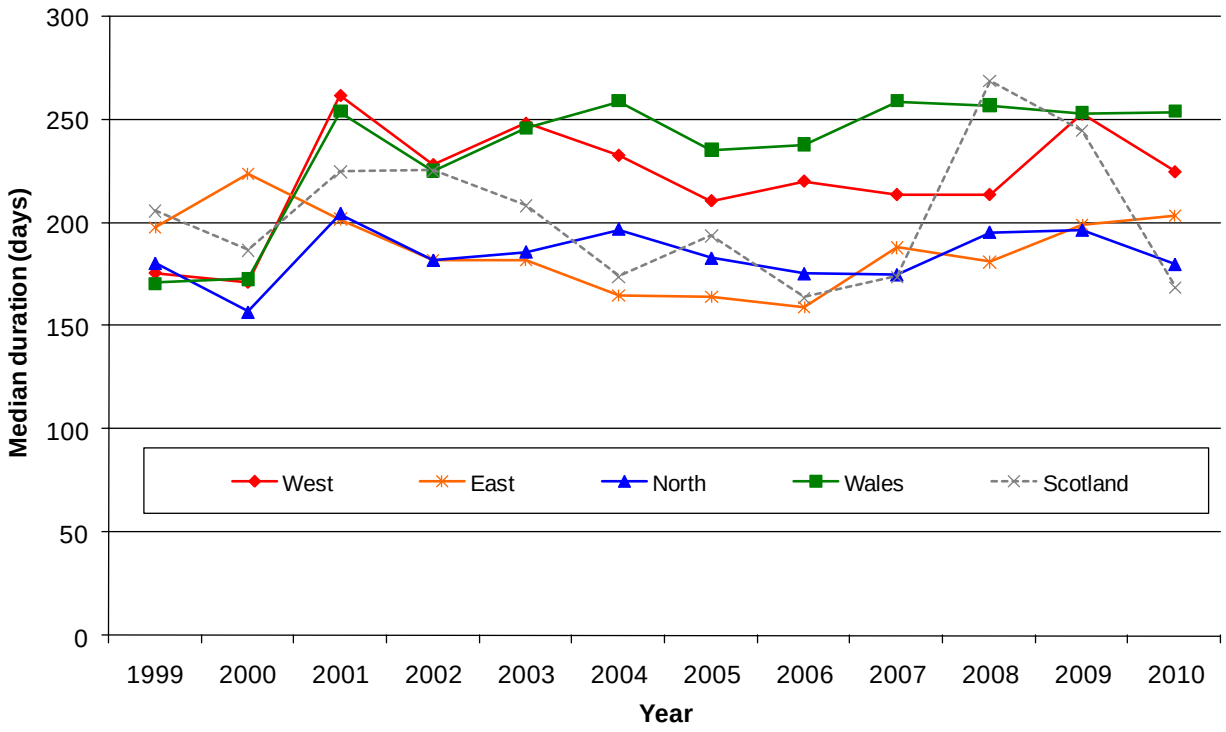

Figure C3: Median duration of OTF-W incidents ending between January 1999 and December 2010, by Reporting Region.

Since 2001, Wales has shown a consistently prolonged duration exceeding that for the West Region until 2009. The median duration of incidents in the East region has been climbing since 2006 and continued to rise in 2010. Decreases were recorded in the West and North Regions and in Scotland.

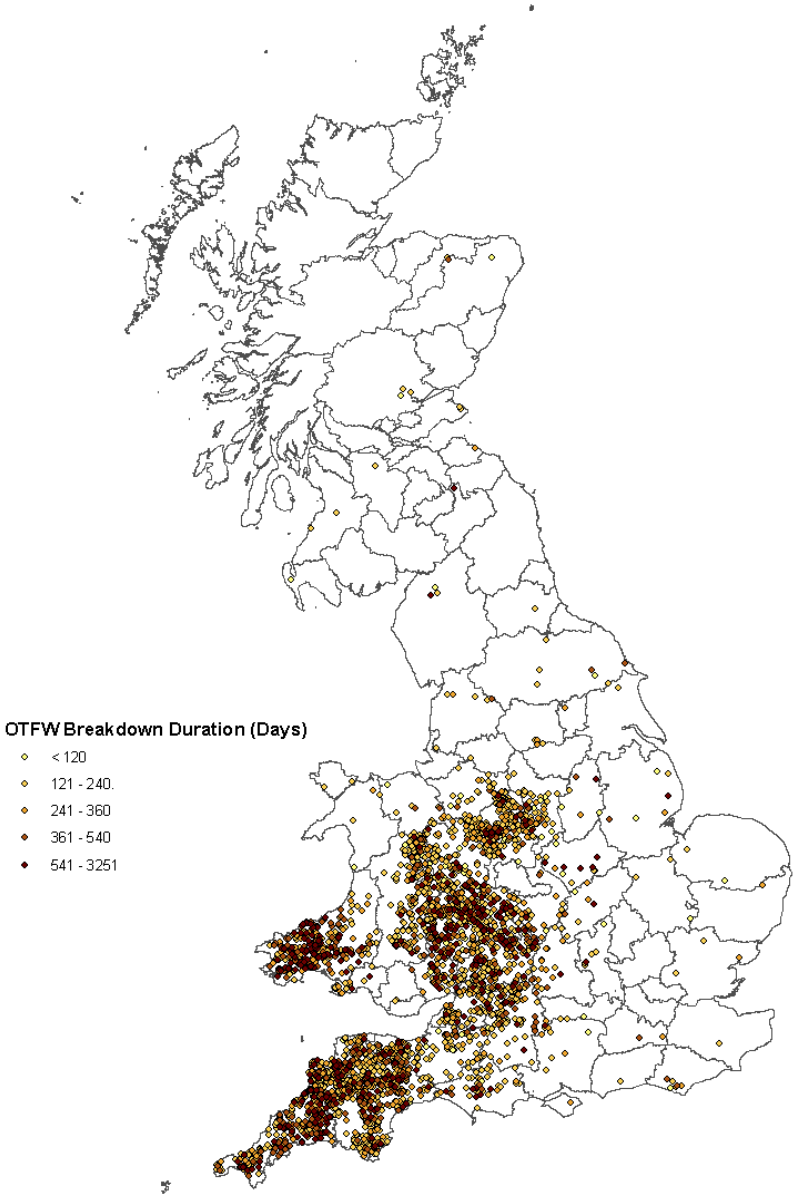

Figure C4: Geographic distribution of OTF-W bovine TB incidents that ended in 2010, according to their duration.

Outside endemic areas, OTF-W incidents of long duration (>365 days) were also recorded in Aberdeenshire and Roxburgh in Scotland, and in Cheshire, Cumbria, Derbyshire, Hampshire, Lancashire, Leicestershire, North Yorkshire, Northamptonshire, Nottinghamshire, Oxfordshire and Surrey. OTF-W incidents of more than three years duration were predominately located in the West, South West and Wales, but there were incidents in Leicestershire, Hampshire and Northamptonshire.

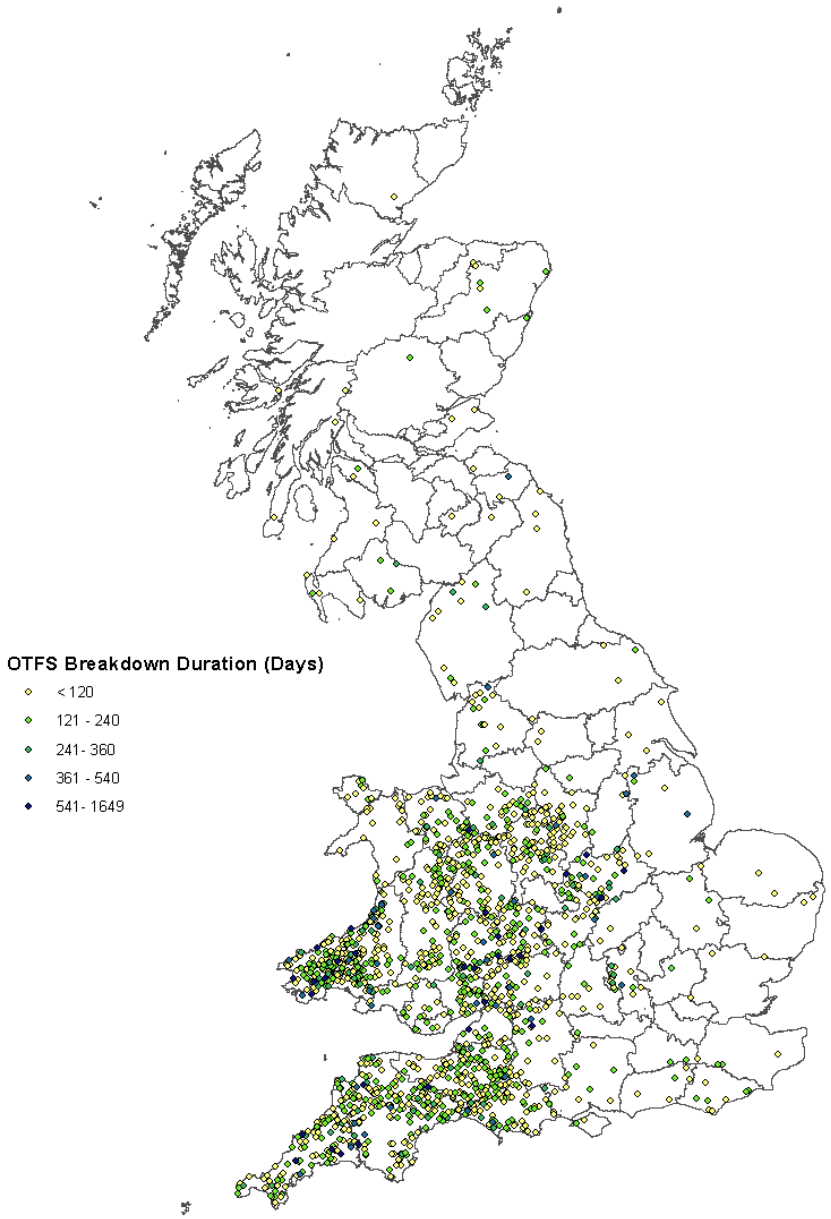

Figure C5: Geographic distribution of OTF-S bovine TB incidents that ended in 2010, according to their duration.

As with OTF-W incidents, OTF-S incidents that were restricted for longer than a year were predominantly clustered in the endemic regions of Wales and South West England, and in Berwickshire, Buckinghamshire, Derbyshire, Lancashire, Lincolnshire and Nottinghamshire. There were 4 OTF-S breakdowns that ended restrictions after 3 years. These were a dairy herd in Dyfed, and a beef herd in Cornwall, and a dairy and a beef herd in Hereford & Worcester.

D. The number of reactors per incident and per square km

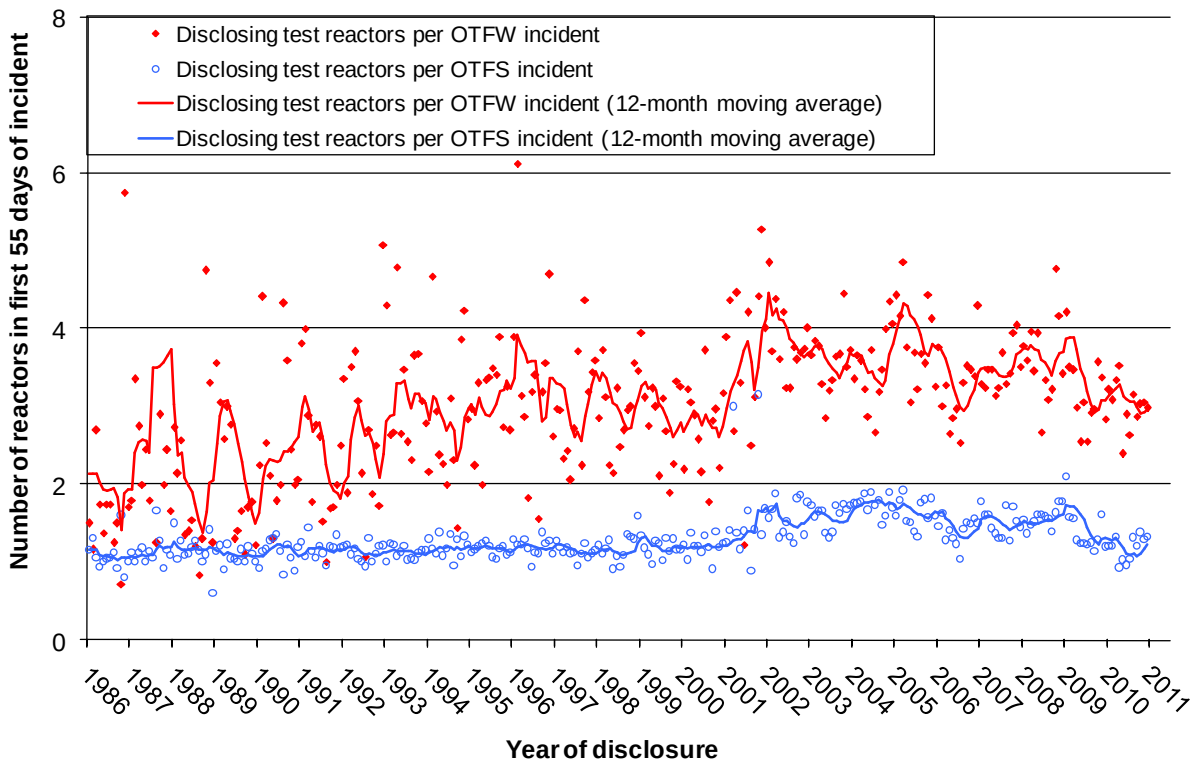

Figure D1: The mean monthly number of reactors per OTF-W and OTF-S incident at the disclosing test between January 1986 and December 2010

A decrease in the number of reactors per OTF-W incident between 2005 and mid-2006 was followed by a gradual increase up to the end of 2008. The number of reactors at the disclosing test per OTF-W incident tended to decrease non-significantly during 2009 and 2010.The number of reactors per OTF-S incident has been decreasing since 2009 and through 2010 to pre-2001 levels.

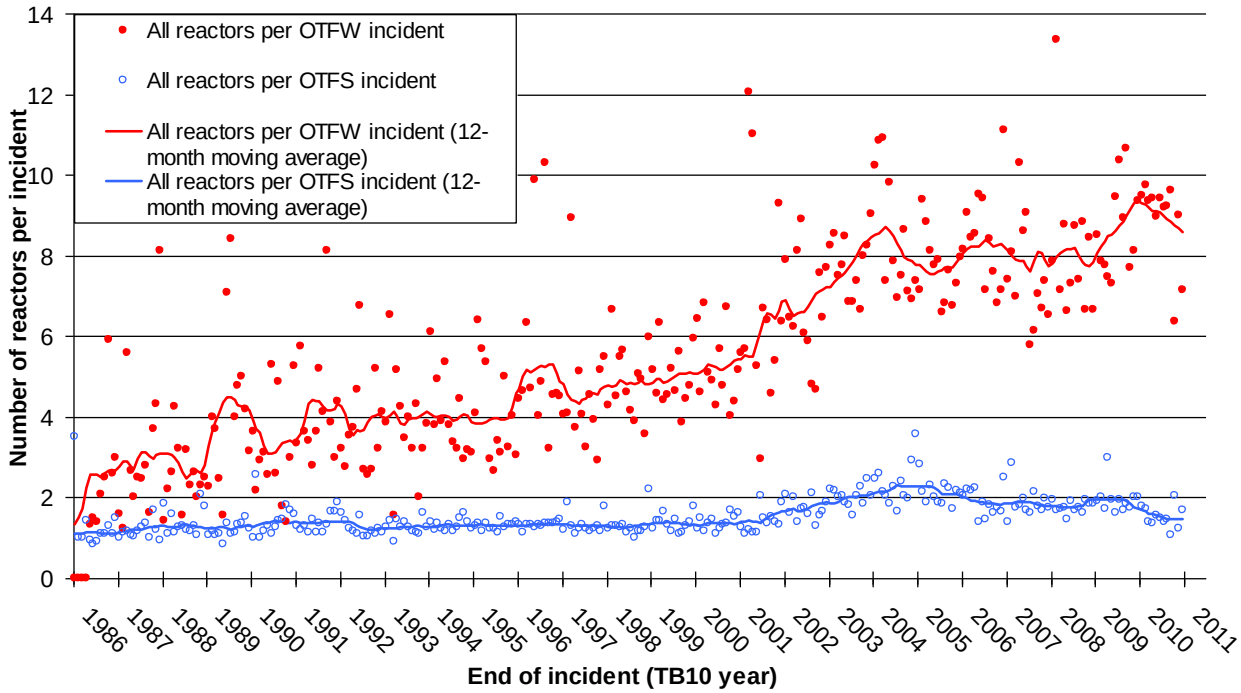

Figure D2: The mean <u>total</u> monthly number of reactors taken per OTF-W and OTF-S incident that closed between January 1986 and December 2010

As in the 2009 report, all incidents presented in Figure D2 are closed, and, as the year of closure is used, incidents contributing to each year may be different to the incidents contributing to the same year in figure D1. The total number of reactors removed in a OTF-W breakdown reached a peak towards the end of 2009, although there was no significant change in the mean number of reactors in 2009 (8.70) to 2010 (9.0). The total number of reactors removed in an OTF-S breakdown has been slowly declining since 2005 and was significantly lower in 2010 compared with 2009.

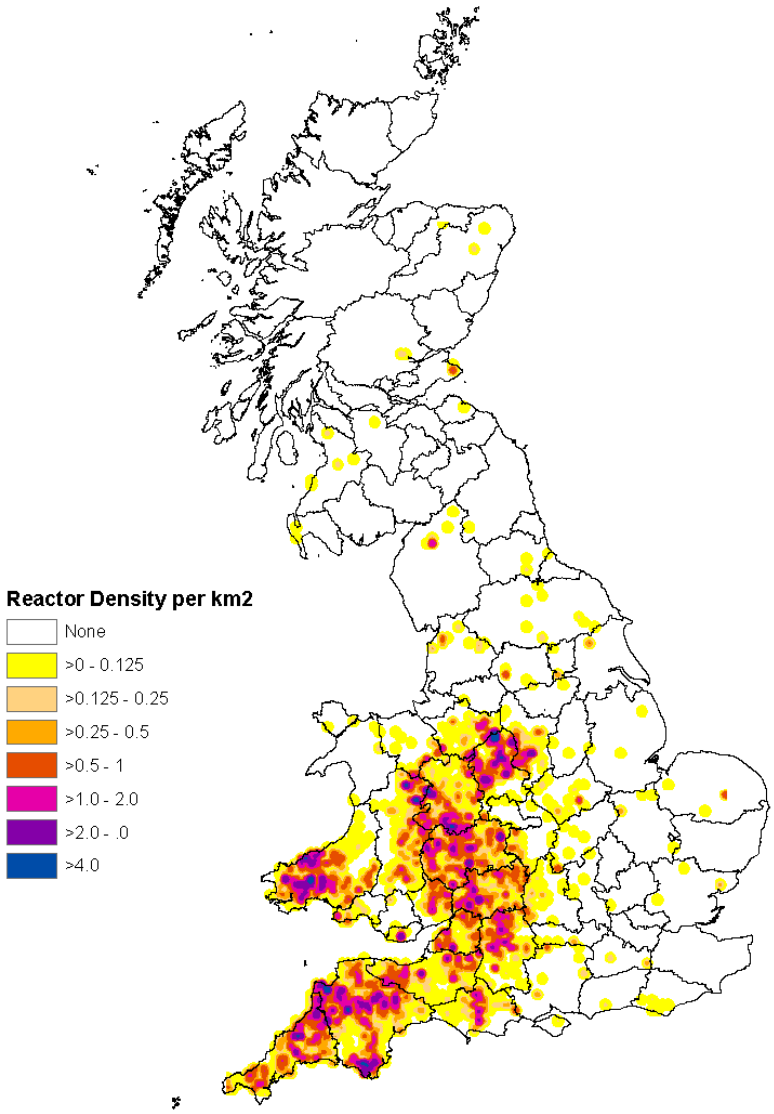

Figure D3: Density of skin test, IFN-gamma test reactors and slaughterhouse cases in OTF-W incidents per km² taken in 2010

Only animals in OTF-W incidents that were taken during the reporting year are included in Figure D3, and comprise skin test reactors, IFN-gamma test reactors and OTF-W slaughterhouse cases. Data was calculated for 5 x 5 km² map squares and was kernel-smoothed using a 6 km search radius. Dyfed, Powys, Devon, Cornwall, Wiltshire, Somerset, Derbyshire, Dorset, Hereford and Worcestershire, Shropshire, Gloucestershire, Staffordshire and Gwent contained substantial areas in which the density was greater than 1 per km², the overall pattern of reactor density remains similar to 2009.

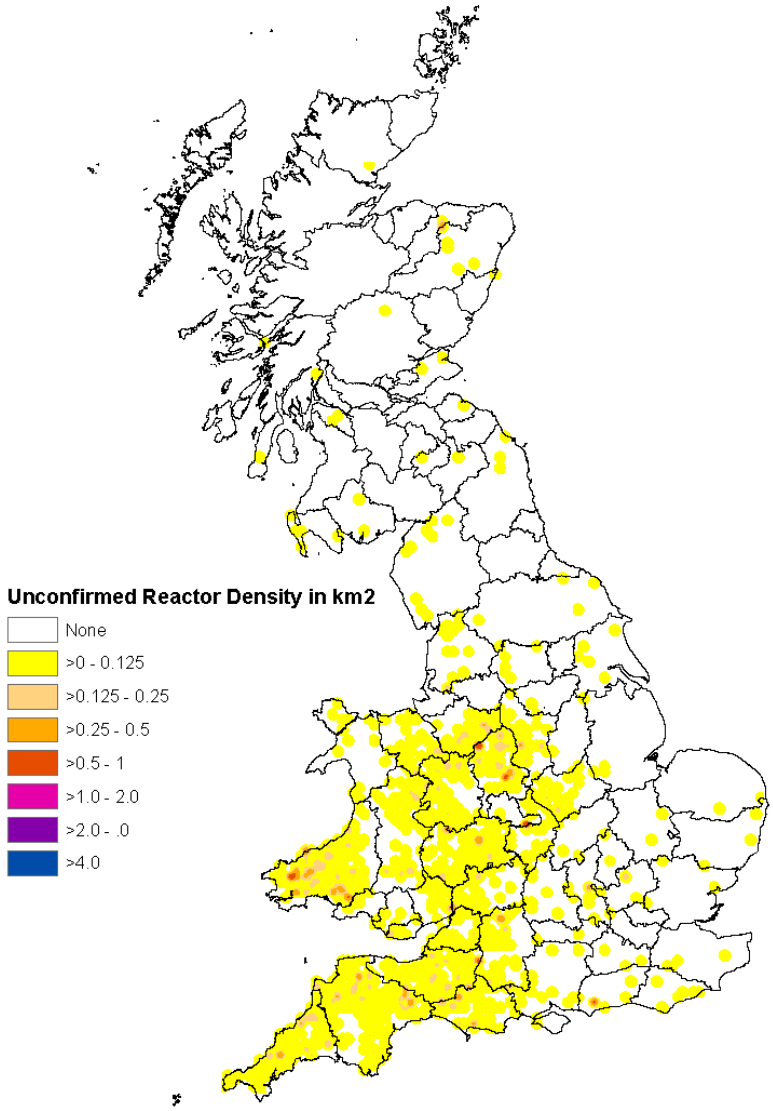

Figure D4: Density of skin test reactors taken in OTF-S incidents per km² in 2010

Figure D4 was created using the same kernel smoothing parameters and shown with the same legend as Figure D3. There were high densities of reactors in OTF-S incidents in Dyfed and Staffordshire, as one might expect. Whilst this is similar in pattern to 2009, the densities are lower than in 2009, even in the major areas.

E. The effect of parish testing interval and test type

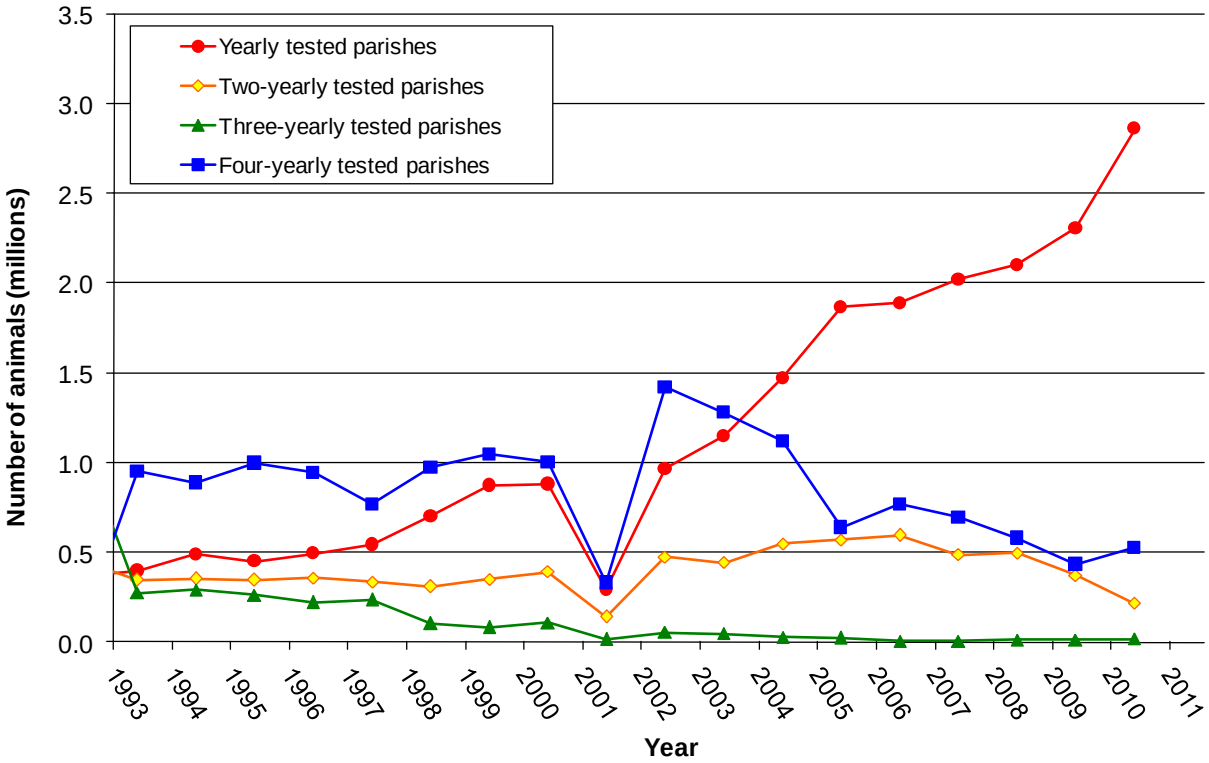

Figure E1: Number of whole herd type tests in animals in unrestricted herds in GB (i.e. excluding short interval tests) within parish testing intervals between January 1993 and December 2010

Apart from the small number of animals tested in whole-herd type tests in all parish testing intervals in the year of the major Foot and Mouth Disease epidemic of 2001, the steady and rapid increase in the number of animals tested in yearly parishes since 1993 continued through 2009 and sharply increased in 2010, when all parishes in whole counties in West Region were moved onto yearly testing. Although it has been falling since 2002, the number of animals tested in four-yearly parishes rose in 2010 in accord with a four-year cycle commenced in 2002, after FMD. The number tested in two-yearly tested parishes declined sharply as a result of many of these parishes being allocated a yearly testing frequency. There was a slight increase in the number of animals in three-yearly parish testing parishes but three yearly testing remains rare with only 17,509 animals in this testing interval compared with 2.8 million in annually tested parishes.

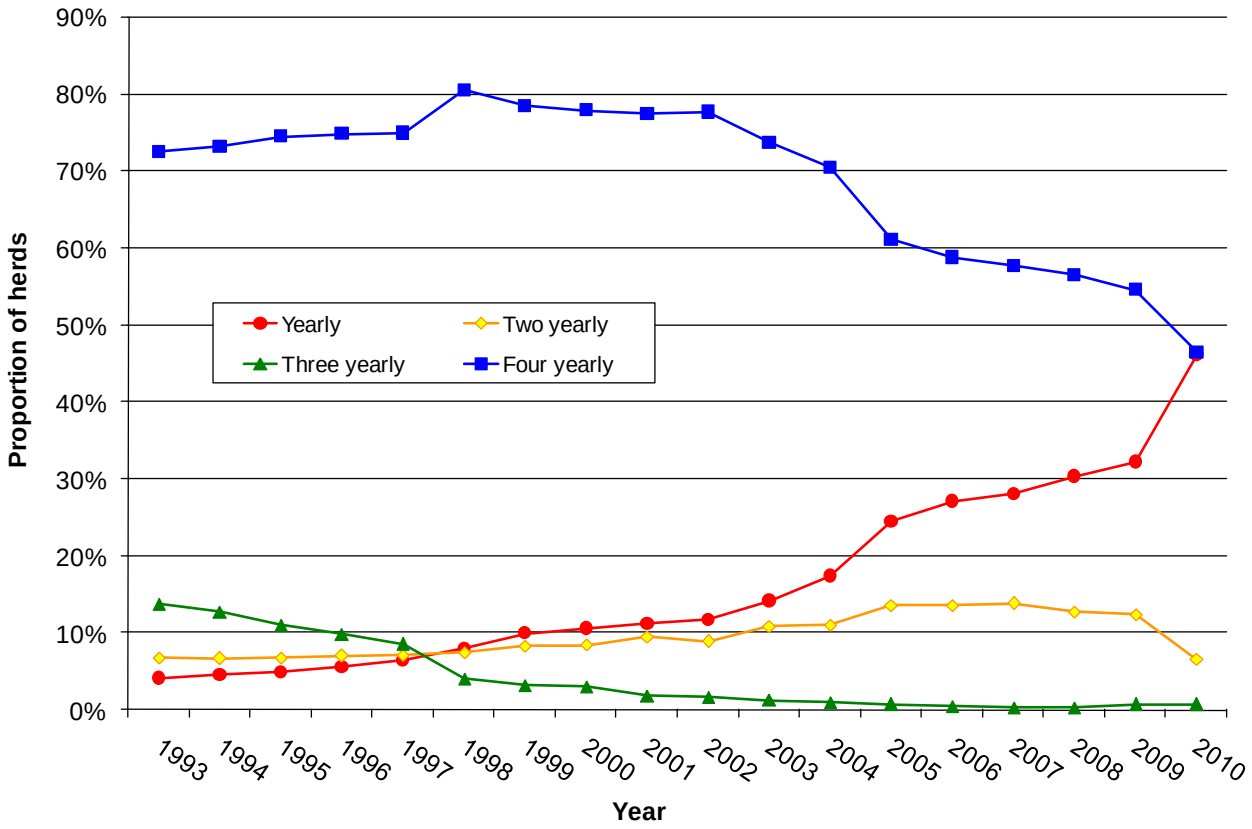

Figure E2: Proportion of live herds in GB within each parish testing interval between January 1993 and December 2010

There were changes in the proportion of herds distributed in the 4 testing intervals between 2009 and 2010. For the first time the majority of herds are not within 4-yearly tested parishes. The proportion of herds on yearly testing increased sharply in 2010, from 32.2% in 2009 to 46.2% in 2010. This was matched by a corresponding drop in the proportion of herds undergoing two and four yearly testing. The proportion of herds in two yearly tested halved, from 12.4% in 2009 to 6.6% in 2010. For the first time the proportion of herds in four yearly tested parishes in 2010 dropped below 50% of herds (46.5%). The proportion of herds on three yearly testing was unchanged, at less than 1%. These changes reflect policy changes that were implemented in 2010 moving higher risk areas into PTI 1.

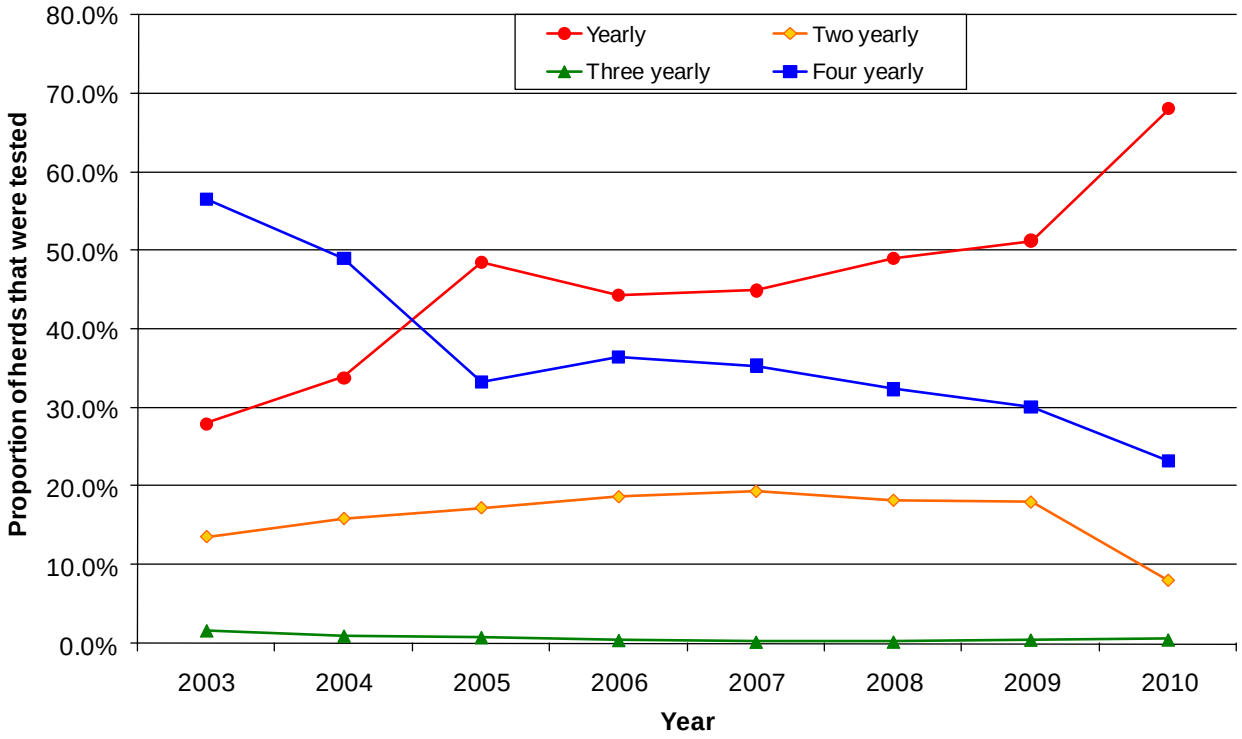

Figure E3: Proportion of tested herds within each parish testing interval between January 2003 and December 2010

Of all the herds that were tested in 2010, 68% were from yearly parishes and only 23% were from four yearly testing. This represents a change from 2009, where just over 50% of these herds were within yearly tested parishes in 2009 whilst 30% were in four-yearly parishes. This in part, can be explained by the decrease in the number and proportion of herds in four yearly testing. There was a 16% drop in the proportion of herds on a 4-yearly testing regime and a corresponding drop in the proportion of herds in four yearly tested parishes actually tested in 2010. This likely reflects policy change rather than the risk profile of the herds tested but a drop in the proportion of herds tested in four yearly testing intervals suggests that there was a bias towards testing a higher risk profile of herd in 2010.

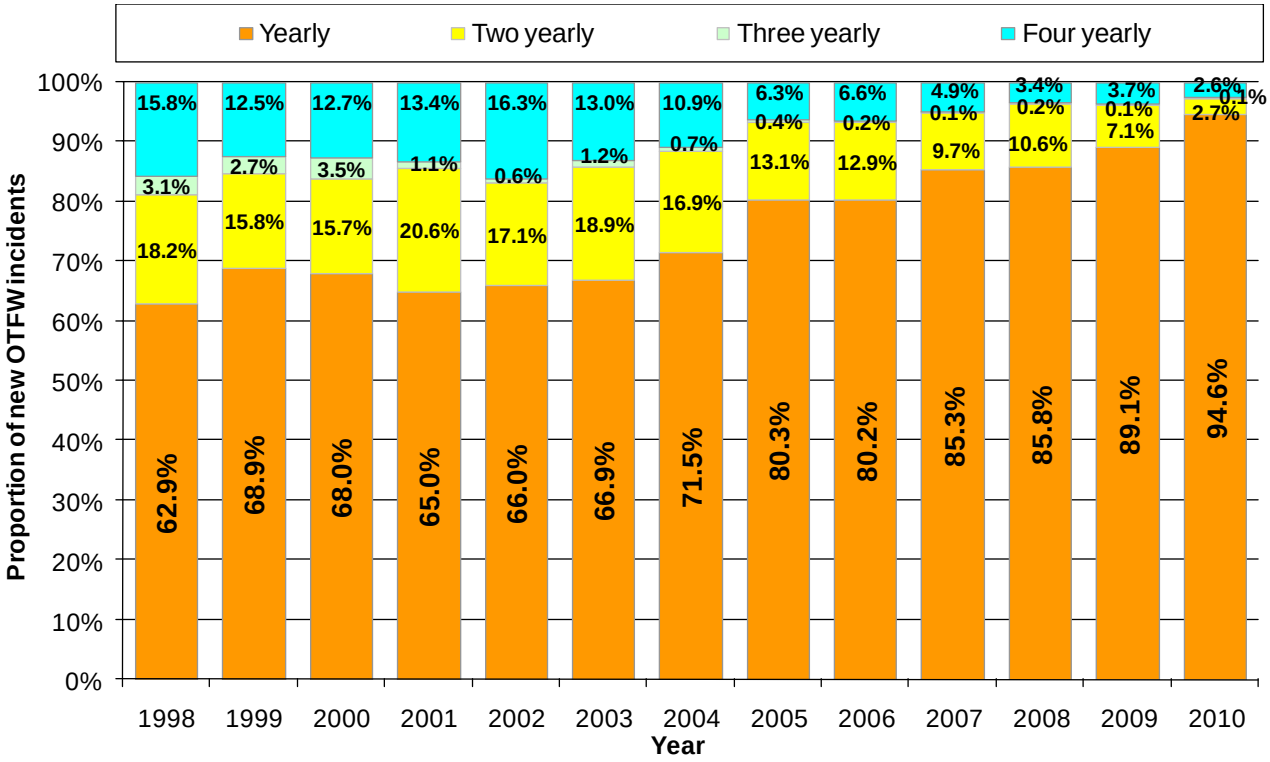

Figure E4: The proportion of OTF-W new incidents occurring in each parish testing interval between January 1998 and December 2010.

A significantly larger proportion of total OTF-W new incidents occurred in yearly-tested parishes in 2010 than in 2009 (95% vs. 89%) (χ^2=152.4, 3 d.f., p< 0.001) continuing the increasing trend that has been observed since 2001 and reflects the rapid increase in the proportion of herds under annual testing. In 2010 only 2.6% of OTF-W new incidents occurred in areas tested four-yearly.

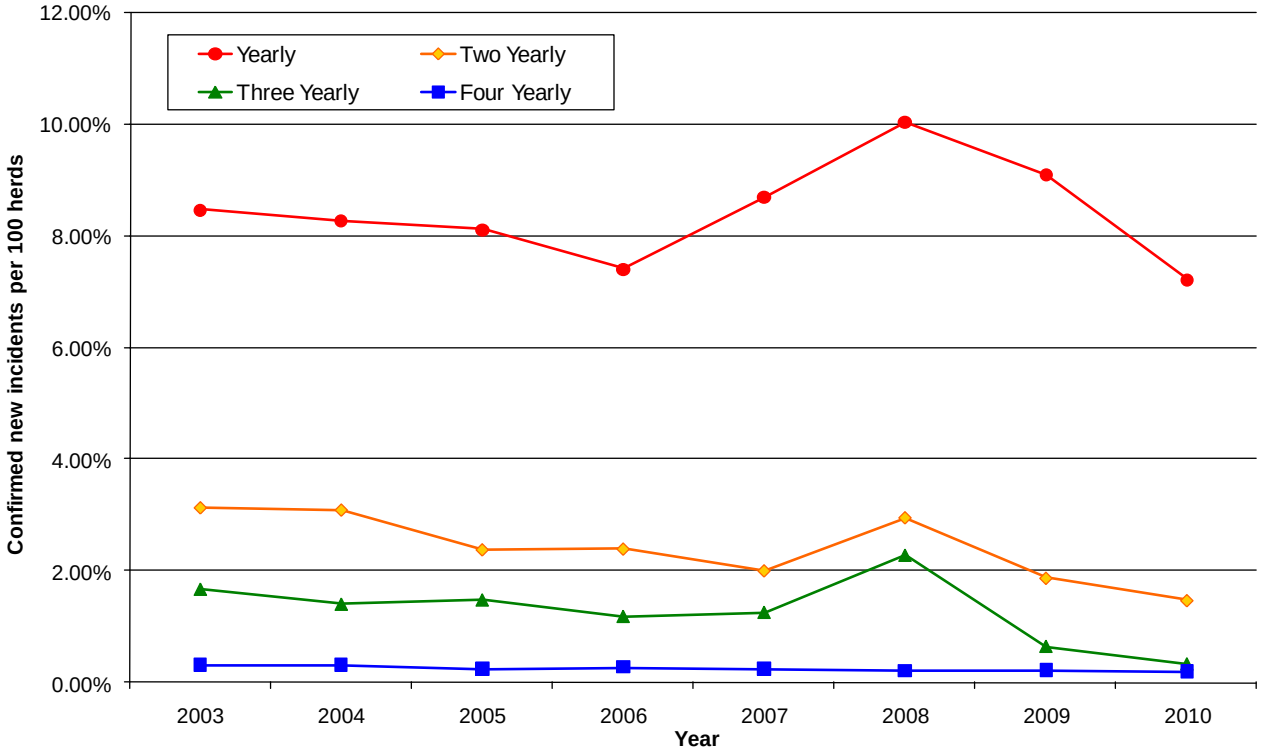

Figure E5: OTF-W new incidents per 100 live herds in different parish testing intervals between January 2003 and December 2010

A reduction in OTF-W new incidents per 100 live herds in yearly tested parishes between 2003 and 2006 was followed by a sharp increase from 7.4% in 2006 to 10% in 2008. The reduction in incidence recorded in 2009 was maintained and incidence in yearly tested parishes fell to 7.2% in 2010 as more, possibly lower risk, herds were moved to annual testing. Although incidence in two-yearly tested parishes transiently increased in 2008, there has been a sharp fall since, most probably a result of the removal of high risk herds from this testing interval into yearly testing.

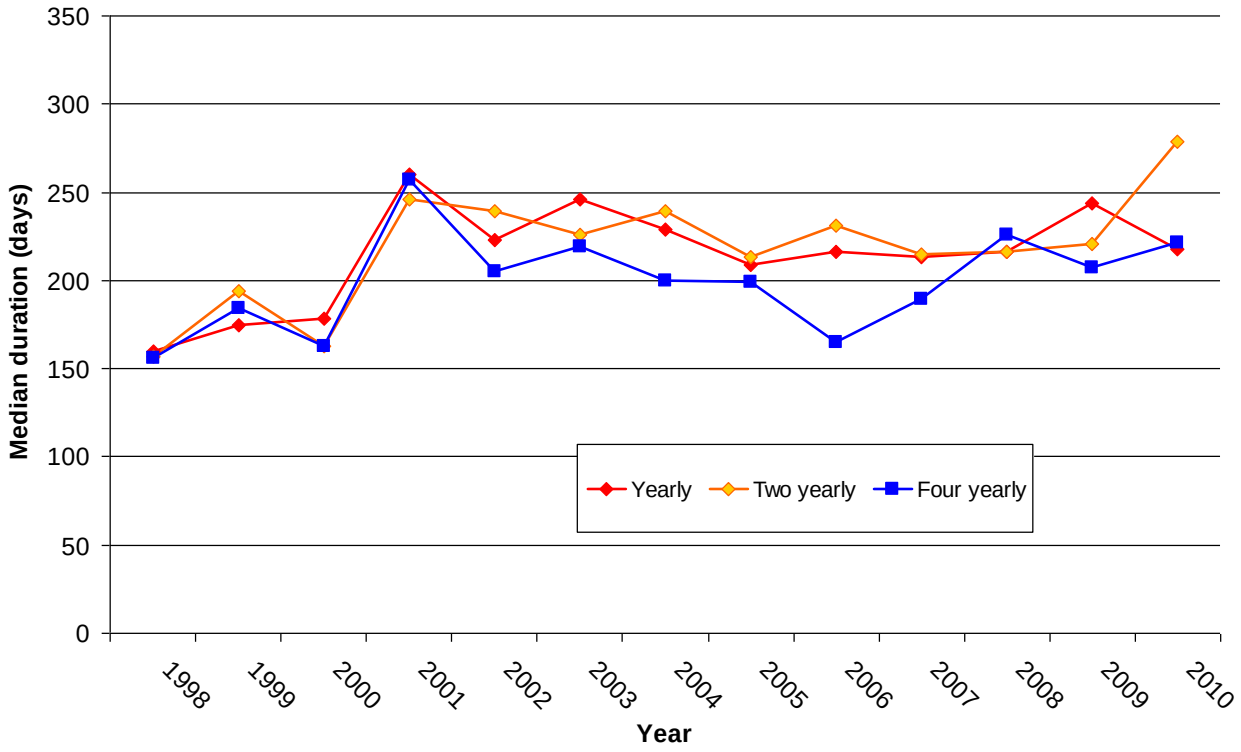

Figure E6: Median duration of OTF-W incidents ending between January 1998 and December 2010, within parish testing interval that was in force at the start of the incident. Interquartile ranges not shown for clarity.

The small number of incidents and live herds in three-yearly tested parishes resulted in a widely fluctuating median duration with time and so has been removed from the figure. Between 1998 and 2009, the median duration in four-yearly tested parishes had tended to be lower than in other intervals, although in 2010 it increased and is similar to the median duration in yearly tested parishes. The median duration of incidents in two-yearly intervals increased in 2010 and was the longest duration of all the test intervals but includes 12 incidents in the West and Wales with durations that exceeded 3 years.

F. Effect of herd size and type

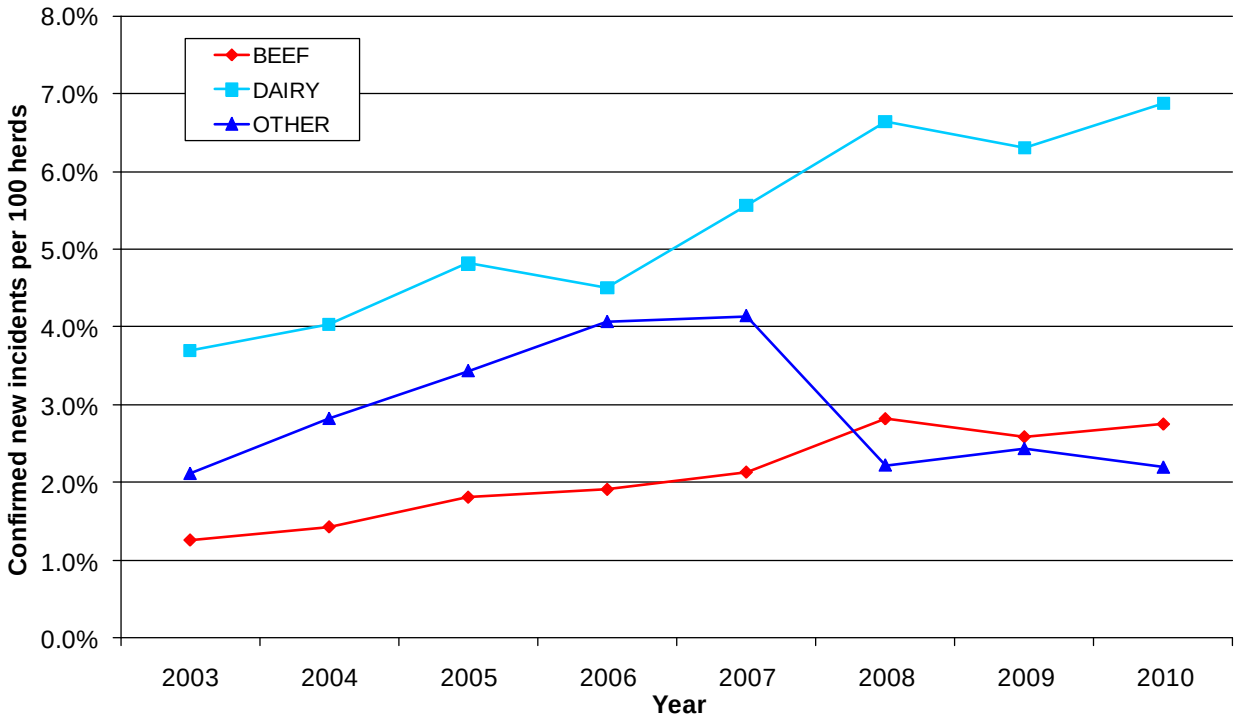

Figure F1: The number of OTF-W new incidents per 100 live herds by herd type between January 2003 and December 2010

OTF-W incidence has been on an upwards trend since 2003 in live Dairy herds and this has continued in 2010, with small decreases in 2006 and 2009. OTF-W incidence in Beef herds has consistently been less than half the incidence in live Dairy herds since 2003. The change in definition of Other herds in 2008 has affected the shape of the graph for this herd category. There was no difference in the number of OTF-W new incidents per 100 live Beef or Other herds in 2010 relative to 2009 but there were more OTF-W new incidents per 100 live Dairy herds between 2009 (6.2%) and 2010 (6.9%).

G. Routine slaughterhouse surveillance

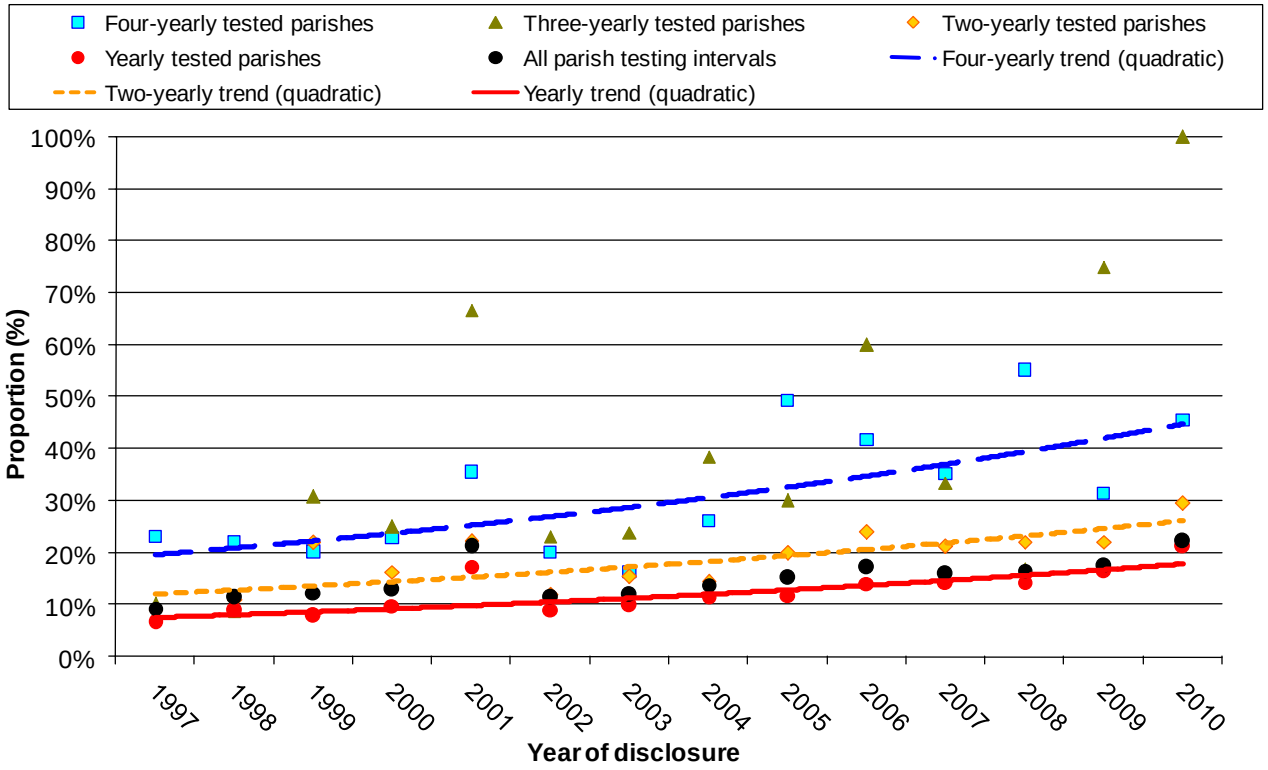

Figure G1: Trends in the proportions of OTF-W new incidents that were disclosed by slaughterhouse cases, by parish testing interval

The proportion of OTF-W new incidents across GB (i.e. all testing intervals) disclosed by confirmed slaughterhouse cases increased significantly from 17% in 2009 to 22% in 2010. The proportion has tended to increase with time, but it has never been as high as 22% except during the exceptional conditions of the testing standstill in 2001.

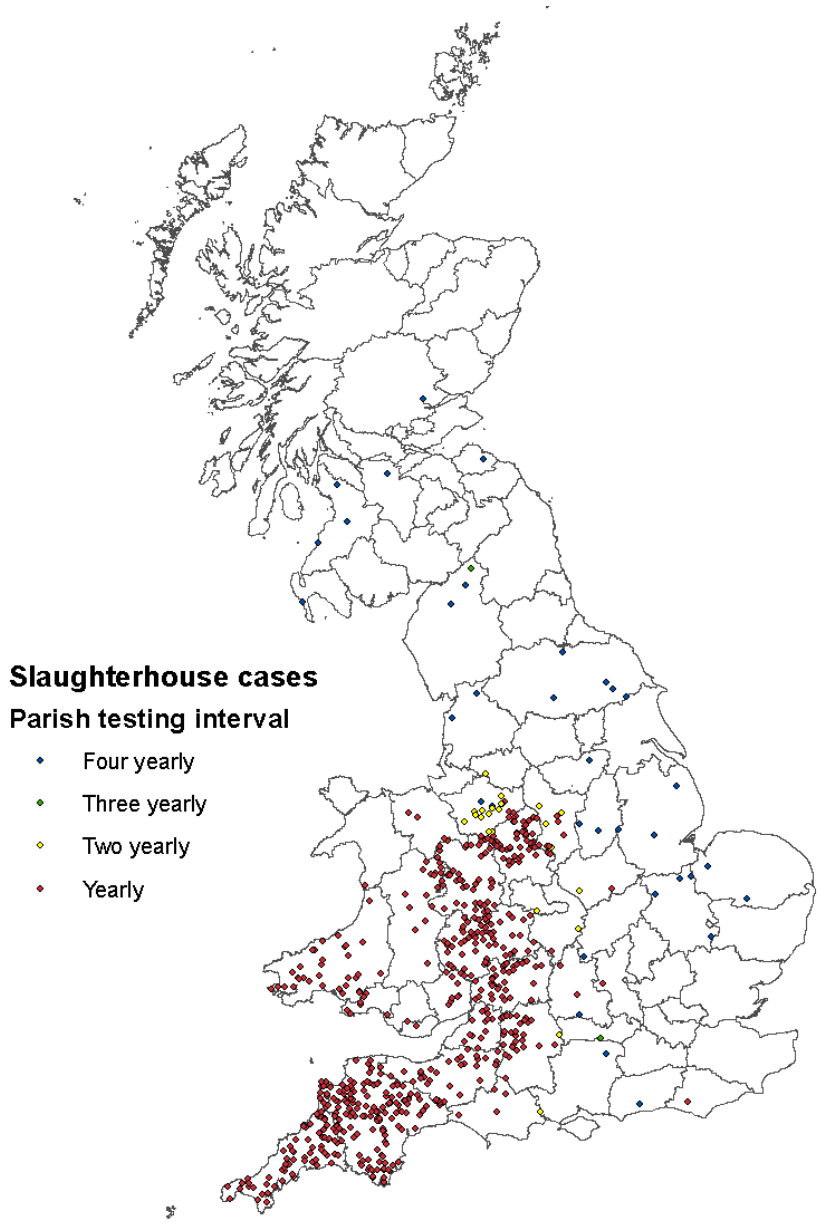

Figure G2: Slaughterhouse cases in 2010, by parish testing interval. Dots represent the location of the herds of origin of the slaughterhouse case, not the location of the abattoir identifying the case.

Slaughterhouse cases are represented in all parish testing intervals and regions. They appear to be most concentrated in the South West, especially in Devon, Hereford & Worcester, Shropshire, Staffordshire, Powys and Dyfed, where their geographical distribution resembled the distribution of confirmed new incidents (Figure B2).

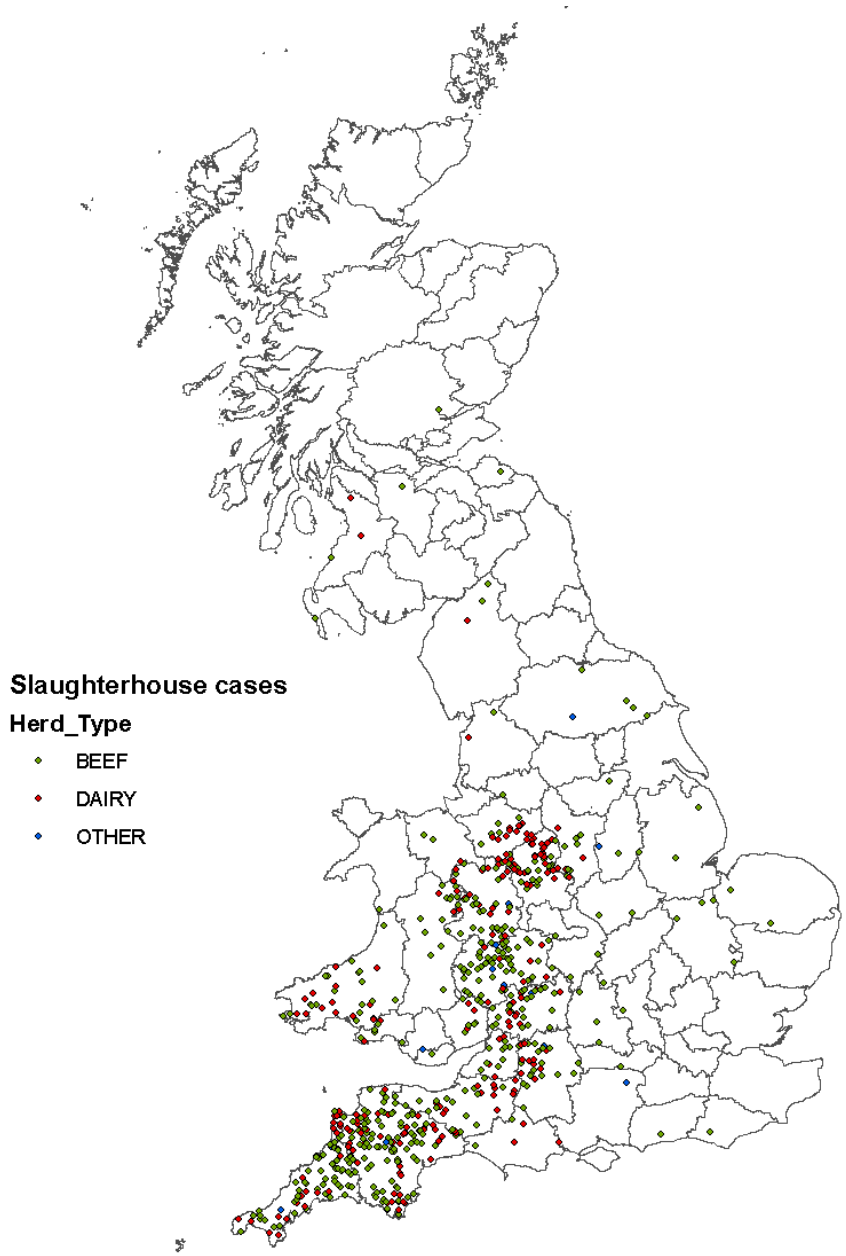

Figure G3: Slaughterhouse cases in 2010, by herd type

Practically all the slaughterhouse cases in East Region and in the eastern part of North Region occurred in *Beef* herds. In West, Wales and the western part of North region, slaughterhouse cases occurred in a mixture of Beef and Dairy herds.

H. Post mortem examination and culture of suspected bTB animals slaughtered for TB control reasons

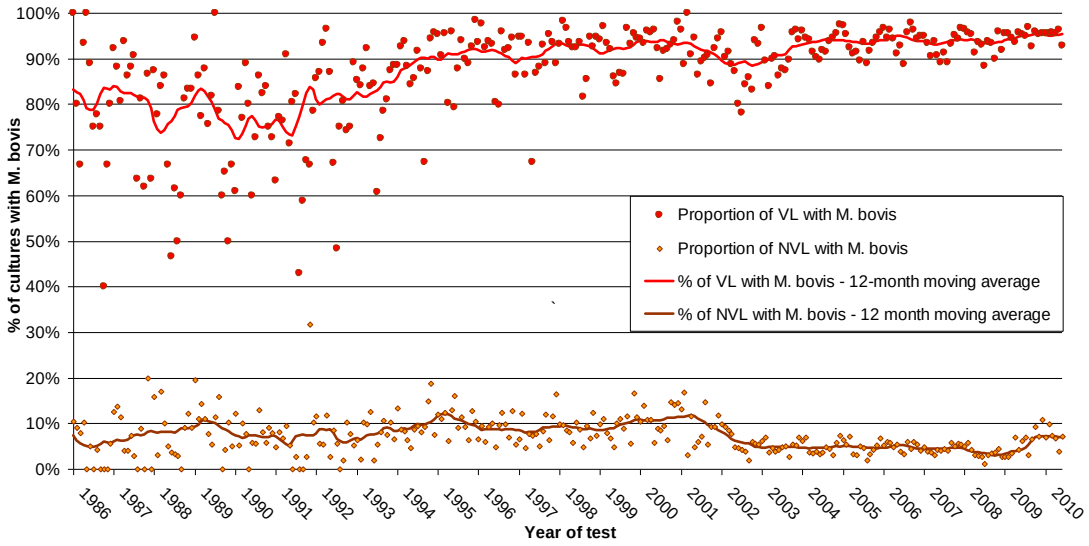

Figure H1 – Proportion of visibly lesioned and non-visibly lesioned submitted for culture from which M. bovis was obtained, by month

The proportion of VL samples from which *M. bovis* was cultured has continues an upward trend starting in mid-2008. The proportion of NVL samples from which *M. bovis* was cultured was also increasing, approaching 10% by the end of 2009. The results were beginning to resemble those for the period 1995-2000, but it is too soon to infer any change in the quality of culture or sensitivity of the skin test.

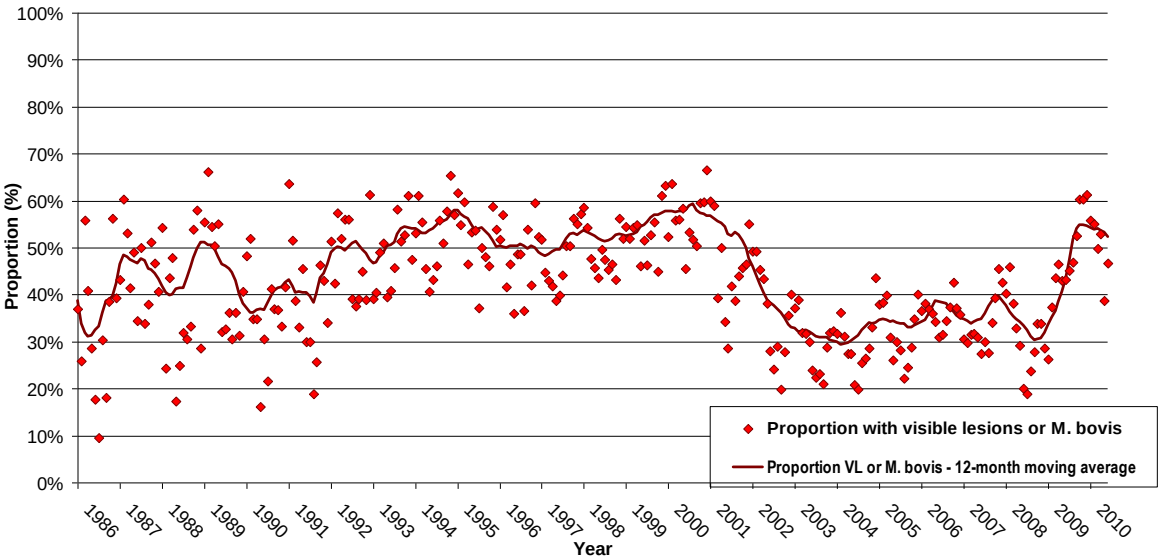

Figure H2: The proportion of all reactors, SICCT (including severe interpretation) and IFN, that were cultured and either had visible lesions or were culture positive in 2010

The proportion of animals with evidence of bovine TB – either having visible lesions or being culture positive – has been low between 2003 and the first part of 2008. Since summer 2008 there has been a steep rise, it is possible that the specificity of the skin test has increased (associated with a concurrent reduction in sensitivity) following the gradual introduction of Lelystad tuberculin and eventual replacement of Weybridge tuberculin.

I. Prospective analyses of herds with breakdowns (recurrent incidents) and herds with only inconclusive reactors in tests

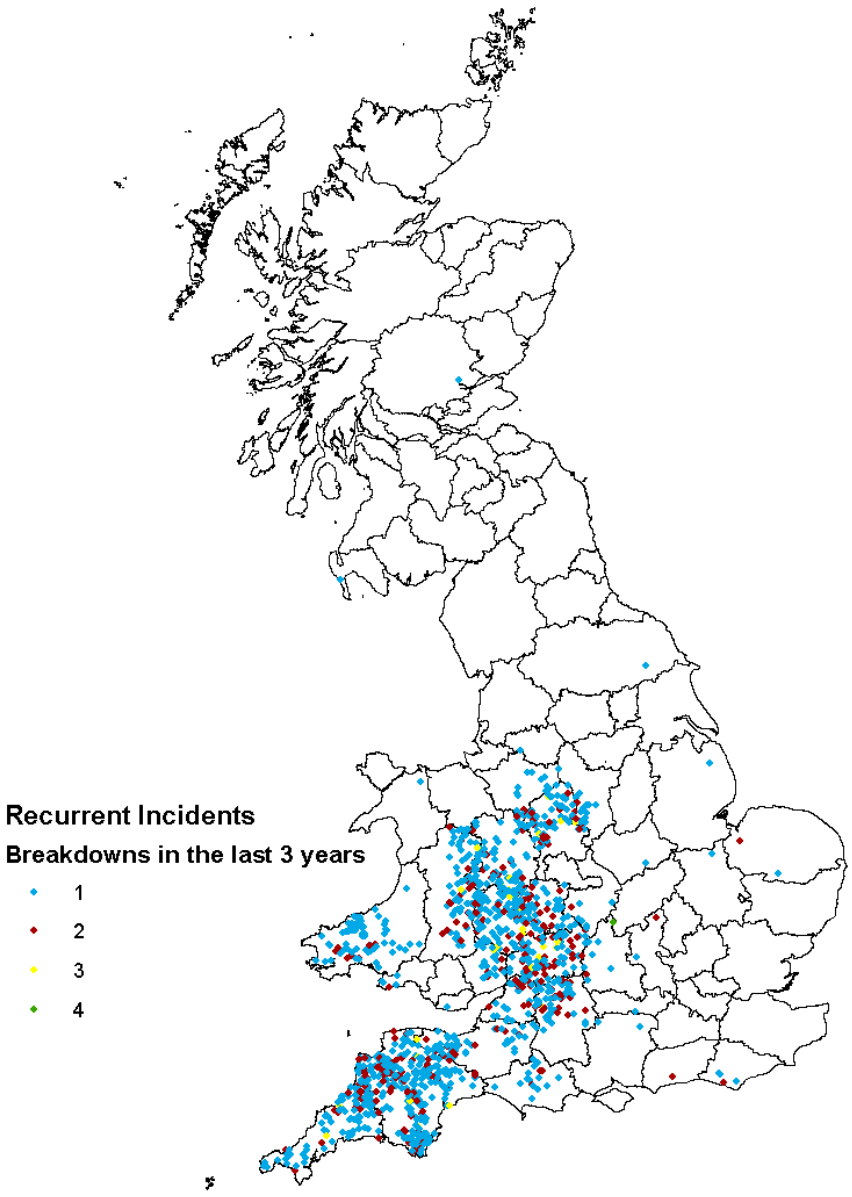

Figure I1 – Geographical distribution of herds with OTF-W incidents ending in the 36-month period before a OTF-W was disclosed in 2010. 18 herds had more than one breakdown in 2010 and the later breakdown was used for these herds.

Herds with a history of OTF-W incident(s) ending in the 36-month History Period that had a recurrent OTF-W in 2010 tended to be concentrated in the higher-incidence areas of GB. The number of OTF-W incidents that occurred in the History Period tends to be greatest in the parts of GB in which "*endemic*" bTB is longer established. At least two herds with an OTF-W new incident in 2010 following a history of **three** OTF-W incidents are seen in Devon, Hereford & Worcester, Gloucestershire, Staffordshire and Cornwall. The two herds that had a history of **four** OTF-W incidents were beef herds in Gloucestershire and Oxfordshire; in at least one of these, only part of the herd appears to have been put under restriction each time.

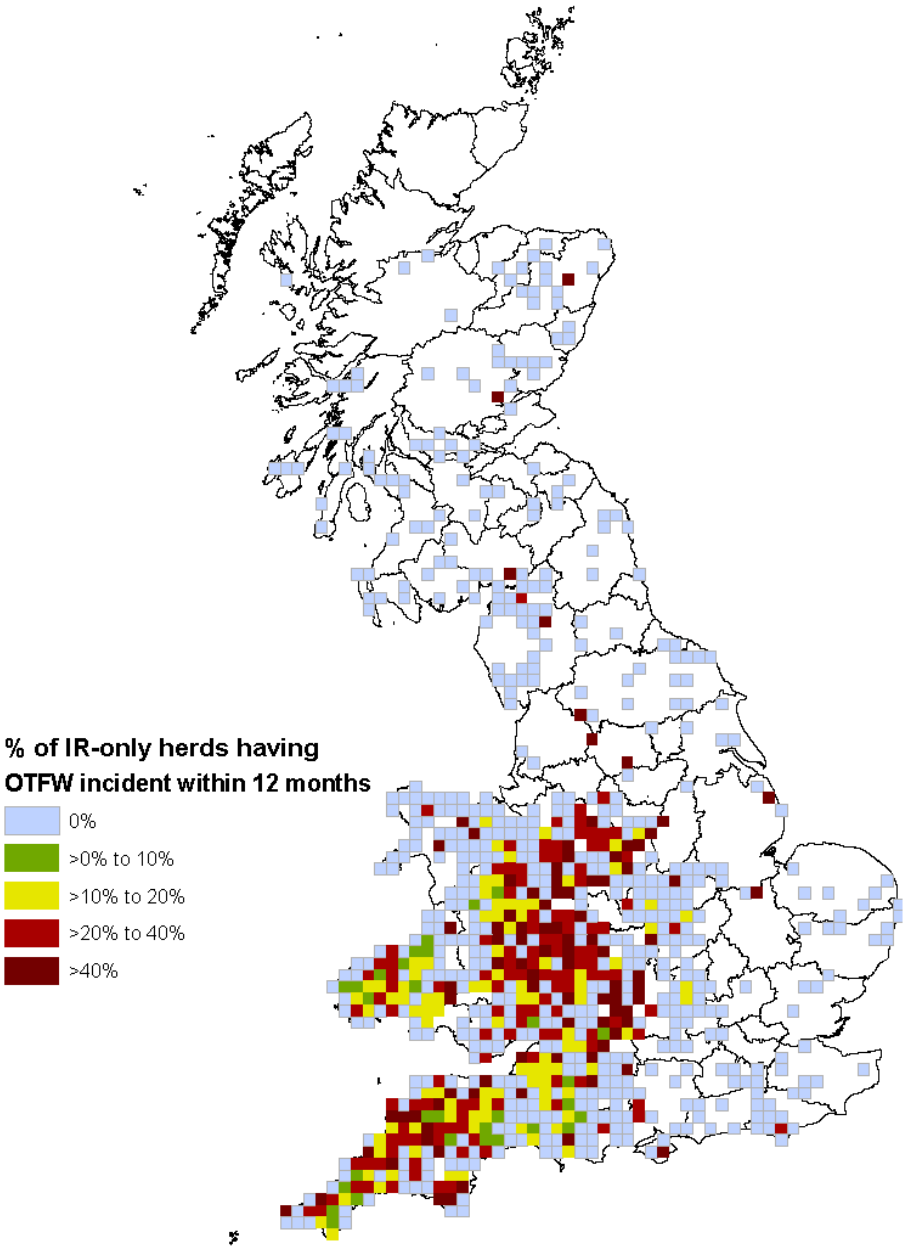

Figure I2: Geographical distribution of herds having inconclusive reactors in 2009 that were followed by an OTF-W bovine TB incident within twelve months, by 10 x 10 km square. Squares with less than 3 IR-only herds are not shown

The geographical distribution of OTF-W new incidents occurring in the follow-up periods six weeks to twelve months after finding IRs in IR-only herds in 2009 is shown in 10 x 10 km map squares. Shading represents the proportion of IR-only herds having an OTF-W new incident, provided that at least three IR-only herds were recorded. In blank squares there were two or fewer IR-only herds. Most of the isolated patches with unexpectedly large proportions shown in earlier reports have been screened out by excluding squares with fewer than three IR-only herds. In endemic areas in the West Midlands, South West, Welsh Borders and South West Wales, the proportion of "IR-only" herd tests that had an OTF-W new incident in the Follow-up Period was greater than in areas peripheral to these.

J. Report on the spoligotype database for 2010 (SB4020)

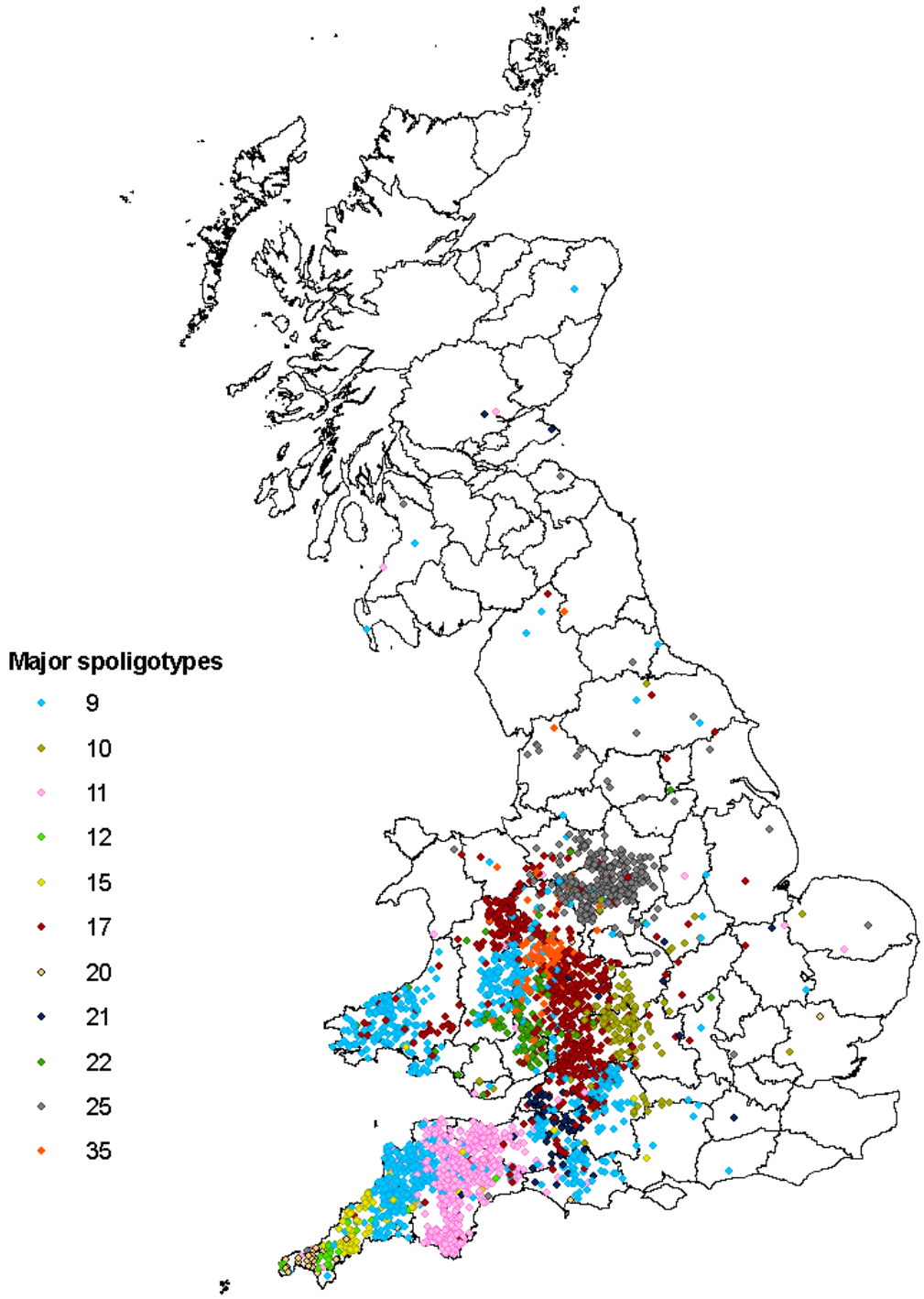

Figure J1: Locations of cattle incidents with one of the 11 major spoligotypes isolated in 2010

The locations of cattle incidents where specimens yielded one of the eleven major spoligotypes are shown in Figure J1, and locations yielding one of sixteen minor spoligotypes in Figure J2.

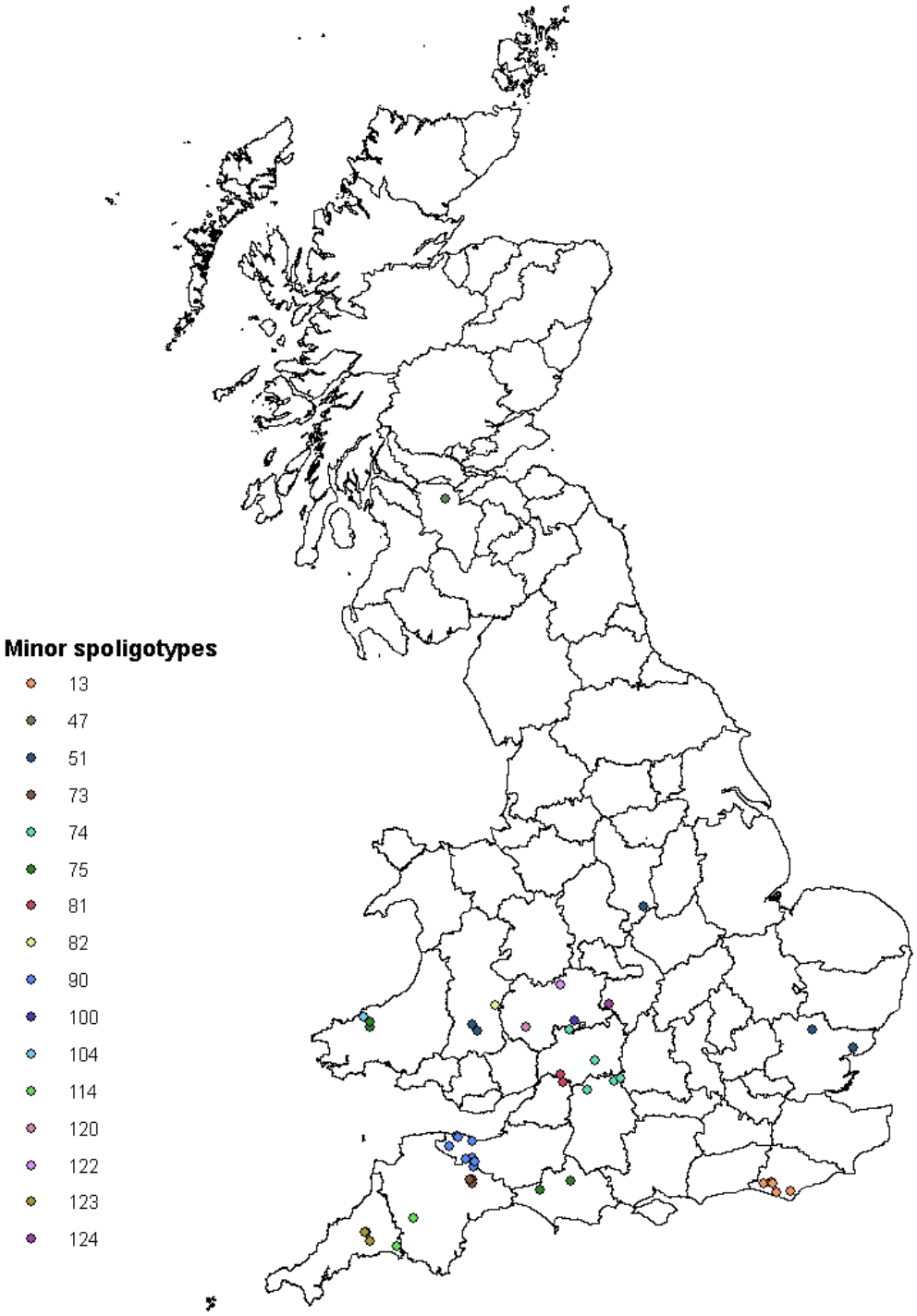

Figure J2: Locations of cattle incidents with one of the 16 minor spoligotypes isolated in 2010.

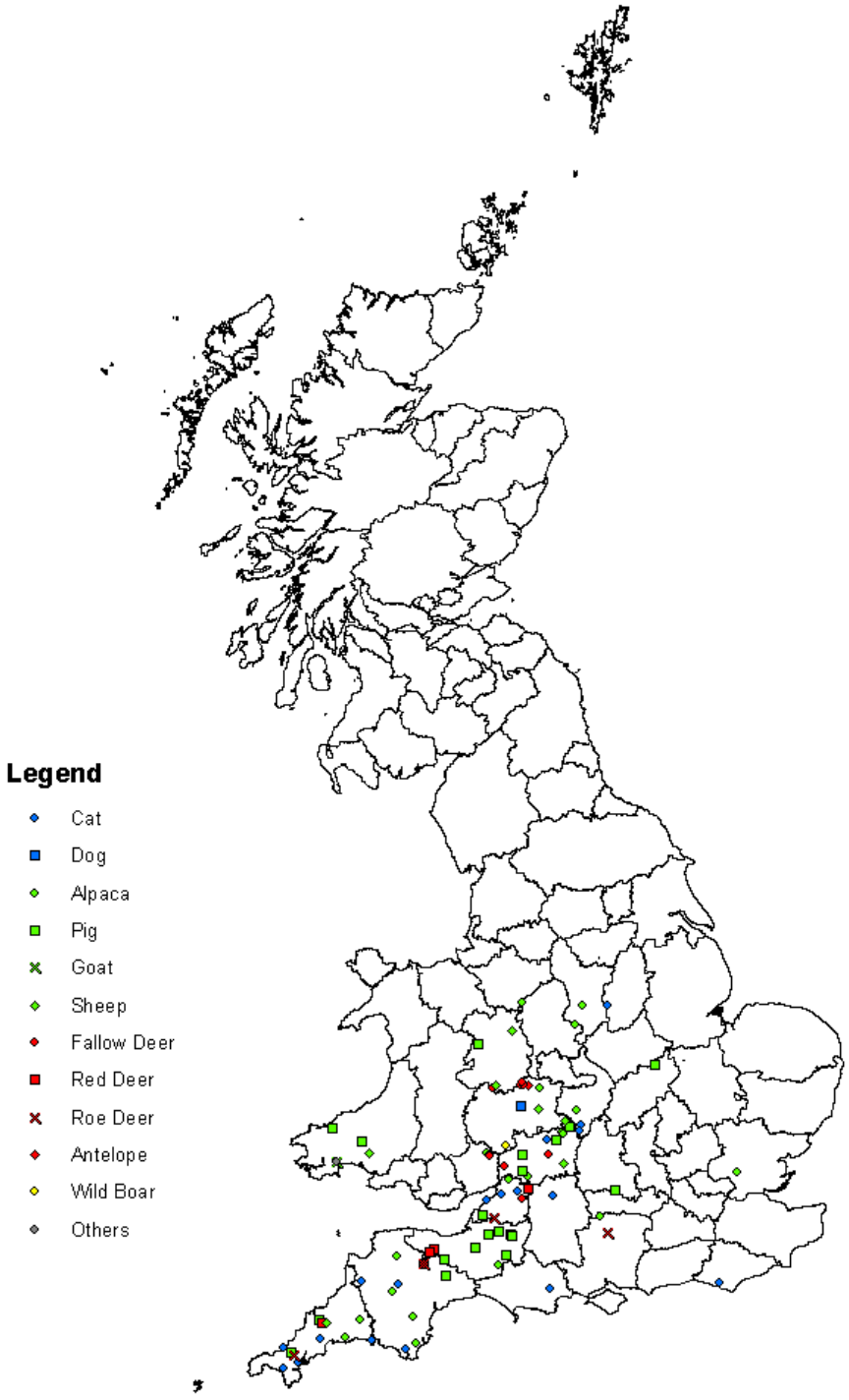

Figure J3: Locations of M. bovis isolates from animal hosts other than cattle and badgers in 2010 where location data exists (129 shown of 139 isolates).

There were 175 mycobacterial isolates genotyped in 2010 from submissions of non-bovine species (242 in 2009). 11 (6%) isolates did not have full VNTR (2009 = 7%). 151 isolates were *M. bovis* and 24 isolates were *M. microti*. The 151 *M. bovis* isolates included 12 badger isolates from Woodchester Park (17:a – in home range) . The remaining 139 *M. bovis* isolates represent 98 separate non-bovine incidents. For non-bovine samples, in general, where home range map analysis is applicable, the genotypes found in non-bovines are in, or very close to, the genotypes found in the local area in cattle. For the 98 separate non-bovine breakdowns it was not possible to carry out home range map analysis for 10 breakdowns (full genotype unavailable or genotype does not have a home range map or location unavailable). Of the remaining 88 cases – 81 breakdowns were in or close to the relevant home range for cattle – only 7 were out of home range.

Appendix Table 2a: Relationship between new Animal Health Regions, Government Offices, AHDOs and Counties in England after the re-organisation in 2009

Reporting Region	Government Office (G.O.) and New AH region	Animal Health Divisional Office (AHDO) and number	Counties (and number of counties)
WEST	South West (SW)	GLOUCESTER (28)	Avon, Gloucestershire, Wiltshire (3 counties)
		TAUNTON (42)	Dorset, Somerset (2 counties)
		EXETER (44)	Devon (1 county)
		TRURO (45)	Cornwall, Isles Of Scilly (2 counties)
NORTH	West Midlands (WM)	WORCESTER (27)	Hereford & Worcester, Warwickshire, West Midlands (3 counties)
		STAFFORD (24)	Shropshire, Staffordshire (2 counties)
	North East (NE)	NEWCASTLE (1)	Cleveland, Durham, Northumberland, Tyne & Wear (4 counties)
	North West (NW)	PRESTON (8)	Cheshire, Cumbria, Greater Manchester, Lancashire, Merseyside (5 counties)
	Yorkshire & Humberside (YH)	LEEDS (7)	Humberside, North Yorkshire, South Yorkshire, West Yorkshire (4 counties)
	East Midlands (EM)	LINCOLN (12)	Lincolnshire, Nottinghamshire (2 counties)
		LEICESTER (21)	Derbyshire, Leicestershire, Northants (3 counties)
EAST	East of England (EE)	BURY ST EDMUNDS (17)	Cambridgeshire, Norfolk, Suffolk (3 counties)
	EE or London	CHELMSFORD (33)	Greater London, Bedfordshire, Essex, Hertfordshire (4 counties)
	SE or London	REIGATE (35)	Middlesex, East Sussex, Kent, Surrey, West Sussex (5 counties)
	South East (SE)	READING (29)	Berkshire, Buckinghamshire, Hampshire, Isle Of Wight, Oxfordshire (5 counties)
WALES		CAERNARFON (47)	Clwyd, Gwynedd, Powys (Northern part, parish numbers 52101 to 52169) (2 + 1 part county)
		CARDIFF (56)	Gwent, Mid Glamorgan, South Glamorgan, West Glamorgan, Powys (Southern part, parish numbers 52001 to 52091 and 52201 to 522264) (4 + 1 part county)
		CARMARTHEN (57)	Dyfed (1 county)
SCOTLAND		INVERNESS (61)	Caithness, Inverness-shire, Lewis, Nairn, Ross and Cromarty, Sutherland (6 counties)
		INVERURIE (65)	Aberdeenshire, Banffshire, Kincardine, Moray, Orkney, Shetland (6 counties)
		PERTH (68)	Angus, Argyll, Clackmannan, Dunbartonshire, Fife, Kinross, Perthshire (7 counties)
		AYR (72)	Ayrshire, Bute, Dumfriesshire, Kirkcudbright, Renfrew, Wigtown (6 counties)
		GALASHIELS (78)	Berwickshire, East Lothian, Lanarkshire, Peebles, Roxburgh, Selkirk, Stirling, West Lothian (8 counties)