

**Report on the National Survey to Assess the Presence of
Bleeding Canker of Horse Chestnut Trees
in Great Britain**

Forestry Commission
Plant Health Service
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Summary

Between June and August 2007, the Forestry Commission (FC) undertook a survey of horse chestnut (*Aesculus hippocastanum*) in Great Britain. The purpose was to provide information, based on visual assessment of symptoms, on the likely incidence and severity of the disease known as Horse Chestnut Bleeding Canker, caused by *Pseudomonas syringae* pv *aesculi*. For the purposes of the survey GB was divided up into 11 regions, and within each region a minimum of ten rural and ten urban sites were selected for assessment. A total of 1385 trees from 128 rural sites and 1244 trees in 112 urban sites were inspected. All regions had some symptomatic trees and overall, 44% of the trees inspected in the rural environment and 55% of the urban trees displayed symptoms of the disease, although these would need to be sampled to ascertain if they indeed have the disease. The level of symptomatic trees were especially high in south east England, confirming earlier survey work by Forest Research's Tree Health Division

Purpose of the Survey

This survey was intended to:

- provide an indicator of the frequency and severity of the incidence of bleeding canker in horse chestnut across Great Britain
- provide information on site type and site characteristics, tree size, position and extent of symptoms in order to inform decisions on the future management of the disease.

The survey was not designed to provide data on either the total population of horse chestnut or the total number of trees potentially infected, so the survey results should not therefore be regarded as definitive. Surveyors were also asked to identify if Horse Chestnut Leaf Miner (*Cameraria ohridella*) and Horse Chestnut Scale (*Pulvinaria regalis*) were present but the presence or absence of these two other horse chestnut problems is not discussed in this report.

Background

The disorder known as 'Bleeding Canker of Horse Chestnut' is now thought to be very widespread with thousands of trees affected. The causative organism has recently been identified as *Pseudomonas syringae* pv *aesculi*. Previously, no widespread systematic survey has been undertaken but Forest Research scientists have estimated that some 35,000 to 50,000 trees were affected and probably a few thousand have already been felled for safety reasons as a result of the disease. Horse chestnuts, ranging from 10-15 year old vigorous saplings to large mature trees, can all be affected by the disorder. Many are highly visible amenity trees in parks and public gardens, while others form important features in avenues, historic gardens and landmarks.

Previously, a detailed survey of around 230 horse chestnuts was carried out in Hampshire by Forest Research (FR) and about half was found to be suffering from bleeding canker. A higher proportion of trees in towns and rural areas displayed symptoms compared with woodland trees.

Following discussions between Corporate & Forestry Support (CFS) and FR in 2006, it was agreed that a limited survey should be carried out in 2007 to provide some data on the likely extent of Bleeding Canker of Horse Chestnut in Great Britain. Before undertaking the survey the Technical Services Unit (TSU) of FR undertook a data gathering exercise between January and March 2007 to determine the extent and location of horse chestnut, both on private and publicly owned land throughout Great Britain.

Owners, agents, tree related organisations and local authorities were contacted by letter to ascertain if horse chestnut was present on their property and to seek permission to return to their property to carry out this survey. Training of TSU staff by Tree Health Division (THD), on symptom recognition took place at FR's southern research station at Alice Holt Lodge in April, with the survey commencing in June.

Objective of the Survey

1. To gather data to enable us to give an indication of the extent of Bleeding Canker of Horse Chestnut throughout Great Britain.
2. To assist THD in formulating recommendations and advice on this disease.
3. To enable the FC Plant Health Service to formulate policy on future disease management in GB.

Sampling Protocol

The survey protocol, written by Andy Peace, Statistician, FR Northern Research Station, with additions by Dave Tracy, FC Plant Health Service, included the following parameters:

- i. GB was divided up into 11 regions reflecting a broad geographical spread.
- ii. The survey was not to estimate bleeding canker infection rates for the whole of GB but to provide a snapshot of the extent of the disease using a subset of horse chestnut sites obtained from the initial data gathering exercise. From these subsets, counties, which had sites where 10 trees or more were reported as present, were identified. Each region, except Scotland and Wales, was made up of a number of counties. (See Figure 1)
- iii. Within each region a minimum of 10 rural and 10 urban sites were selected for inspection (see Table 1)
- iv. The sites to be visited were independently selected prior to the start of the survey to prevent bias.
- v. Surveyors operating from each fieldstation could inspect more than the minimum number of locations providing the time taken to inspect the additional sites could be accommodated within the time scale agreed.
- vi. A minimum of 10 trees were inspected for signs of the disease at each location.
- vii. If there did not appear to be any symptoms of the disease on the horse chestnut, the site was recorded as being free from the disease i.e. a negative result.
- viii. A standard *pro forma* was completed for all sites visited. This was used to record basic environmental variables (grid reference; height above sea level etc) and will be used for possible future analysis by THD.
- ix. The diameter of all horse chestnut trees inspected was measured at breast height to the nearest 0.1cm.
- x. Both the stem and the branches were inspected for signs of the disease.
- xi. Four categories of symptoms characteristic of bleeding canker were assessed. These were bleeding on the main stem; bleeding on the branches; cracks in the bark on the branches; dieback in branches.
- xii. No samples were collected although photographs were taken of symptomatic trees to enable subsequent investigation.

Figure 1. Stratification of Horse Chestnut bleeding canker survey into 11 regions.

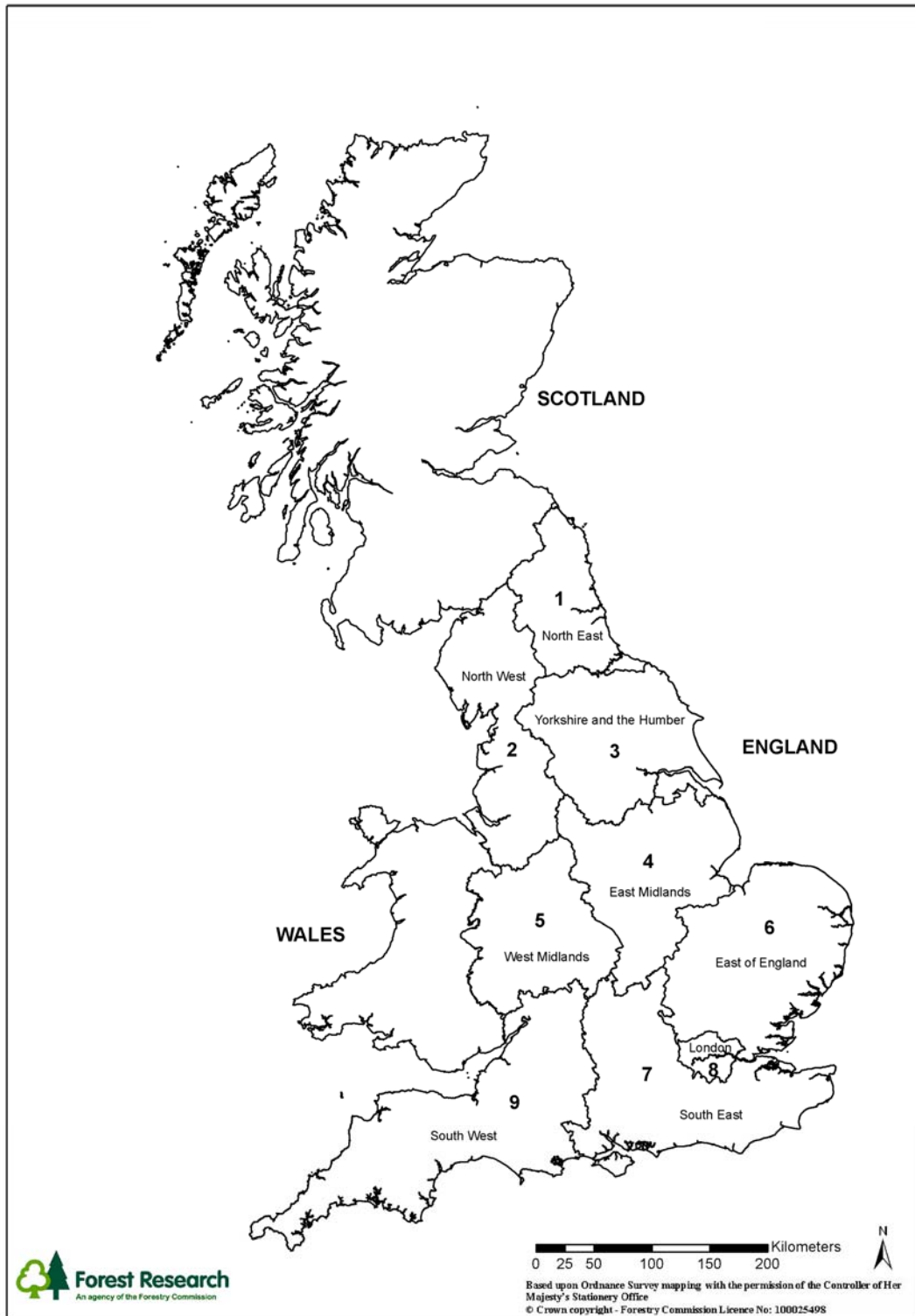


Table 1. Numbers of identified sites with 10 or more Horse Chestnut trees

Region code	Region	Local Authority	No. sites 10+ trees
1	North East England	Northumberland	10
		Tyne & Wear	3
		Durham	5
		Cleveland	1
2	North West England	Cumbria	8
		Lancashire	3
		Merseyside	
		Greater Manchester	4
3	Yorkshire & The Humber	Cheshire	10
		North Yorkshire West Yorkshire South Yorkshire Humberside	42
4	East Midlands	Lincolnshire	25
		Nottinghamshire	11
		Derbyshire	9
		Leicestershire	7
		Northamptonshire	16
5	West Midlands	Staffordshire	8
		Shropshire	12
		Hereford & Worcester	19
		West Midlands	1
		Warwickshire	11
6	East England	Cambridgeshire	9
		Norfolk	27
		Suffolk	17
		Essex	15
		Hertfordshire	13
		Bedfordshire	3
7	South East England	Buckinghamshire	15
		Oxfordshire	20
		Berkshire	3
		Kent	1
		Surrey	1
		East Sussex	
		West Sussex	1
		Hampshire	1
Isle of Wight			
8	London	Greater London	2
9	South West England	Gloucestershire	17
		Avon	7
		Wiltshire	12
		Dorset	11
		Somerset	39
		Devon	24
		Cornwall	
10	Wales		4
11	Scotland		28

Biosecurity

Bleeding Canker of Horse Chestnut is not a quarantine pathogen so there are no statutory requirements in place requiring measures to prevent spread of the disease. However, the Forestry Commission wishes to be seen to be following best practice so surveyors were required to follow the same procedures used, for example, during *Phytophthora* surveys i.e. before leaving the site they would clean off any mud from their footwear (including gaiters or leggings) before washing them with water and applying the general disinfectant Panacide®

Survey Data Summary

Table 2 Incidence of Symptoms of Bleeding Canker on Horse Chestnuts within Each Region

Region Number	Region Name	Number of Trees Assessed		% with symptoms of Bleeding Canker		Regional average (urban & rural)
		Rural ¹	Urban ¹	Rural	Urban	
1	North East England	100 (10)	100 (10)	46%	33%	40%
2	North West England	100 (10)	100 (10)	54%	64%	59%
3	Yorkshire & the Humber	100 (10)	100 (10)	39%	37%	38%
4	East Midlands	132 (10)	102 (10)	35%	47%	41%
5	West Midlands	100 (10)	97 (10)	38%	87%	62%
6	East England	126 (10)	126 (10)	33%	59%	46%
7	South East England	135 (10)	175 (10)	79%	74%	76%
8	London	103 (10)	103 (10)	47%	49%	48%
9	South West England	264 (26)	120 (12)	52%	58%	55%
10	Wales	94 (10)	110 (10)	32%	41%	36%
11	Scotland	131 (13)	111 (10) ²	34%	50%	42%
No. Trees (No. Sites)		1385 (128)	1244 (112)			
Regional Average				44%	54%	49%

¹ = Figures in brackets are the number of sites inspected in each region

² = Two further sites were also visited. The first was found to contain insufficient trees, the second site, the infected trees had been felled by the Council prior to the visit.

Based on the symptoms assessed during this limited survey, it would appear that horse chestnut displaying the symptoms of bleeding canker is more widespread than had been previously thought. By reference to Table 2 it can be seen that of the 1380+ trees assessed in the rural environment, 44% displayed symptoms of bleeding canker, whilst 54% of the 1220+ trees inspected in the urban environment had symptoms. The overall regional average for GB was c.49%. While the south east of England had a high incidence of symptomatic trees (>70%, for both environment types), none of the regions had less than 30% of trees affected by symptoms of the disease. In Scotland the proportion of trees affected was 34% in the rural environment and 50% in the urban environment. Eight of the 11 regions had a higher incidence of symptoms of bleeding canker in the urban environment than in the rural environment, although the percentage levels were only markedly higher in three of these regions viz. West Midlands, East England and Scotland.

Of the four categories of damage/infection symptoms that were recorded (bleeding on the main stem, bleeding on branches, cracks in the bark on branches and branch dieback), stem bleeding and cracking of the bark on individual branches, were by far the most prevalent (see Table 3). Symptoms varied from region to region. South East England, which had the highest incidence of symptoms of bleeding canker for all the regions (mean of 76% for urban and rural - see Table 2), had the lowest proportion of stem and branch bleeds for its symptomatic trees. At the other extreme nearly all symptomatic trees in South West England and Yorkshire and the Humber exhibited stem bleeding.

Table 3 – Percentage of trees exhibiting various symptoms of Horse Chestnut Bleeding Canker

Region	Name	% with Stem bleeds*	% with Branch bleeds*	% of trees with cracking on branches*	% of trees with branch dieback*
1	North East England	92%	52%	72%	44%
2	North West England	79%	35%	83%	38%
3	Yorkshire & the Humber	95%	46%	79%	42%
4	East Midlands	70%	27%	74%	5%
5	West Midlands	67%	25%	75%	25%
6	East England	70%	25%	78%	13%
7	South East England	48%	10%	82%	37%
8	London	57%	24%	77%	27%
9	South West England	93%	52%	72%	28%
10	Wales	91%	17%	61%	28%
11	Scotland	58%	39%	91%	30%
Regional Average		75%	32%	77%	29%

* Combined data for urban and rural sites

Regional differences in the categories of damage/infection symptoms are shown in Figures 2a and 2b below. As seen in Table 3 above, South East England had proportionally fewer symptomatic trees with stem or branch bleeding relative to other

regions. However, in general all regions exhibited similar symptoms between urban and rural environments.

Figure 2a.

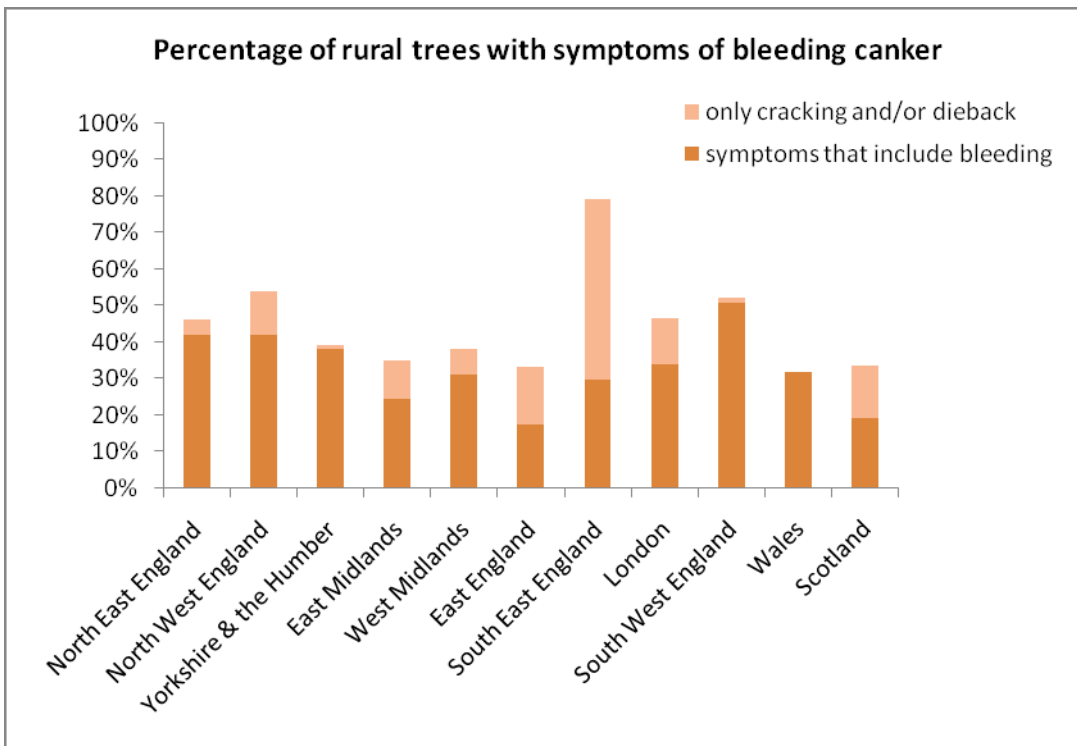
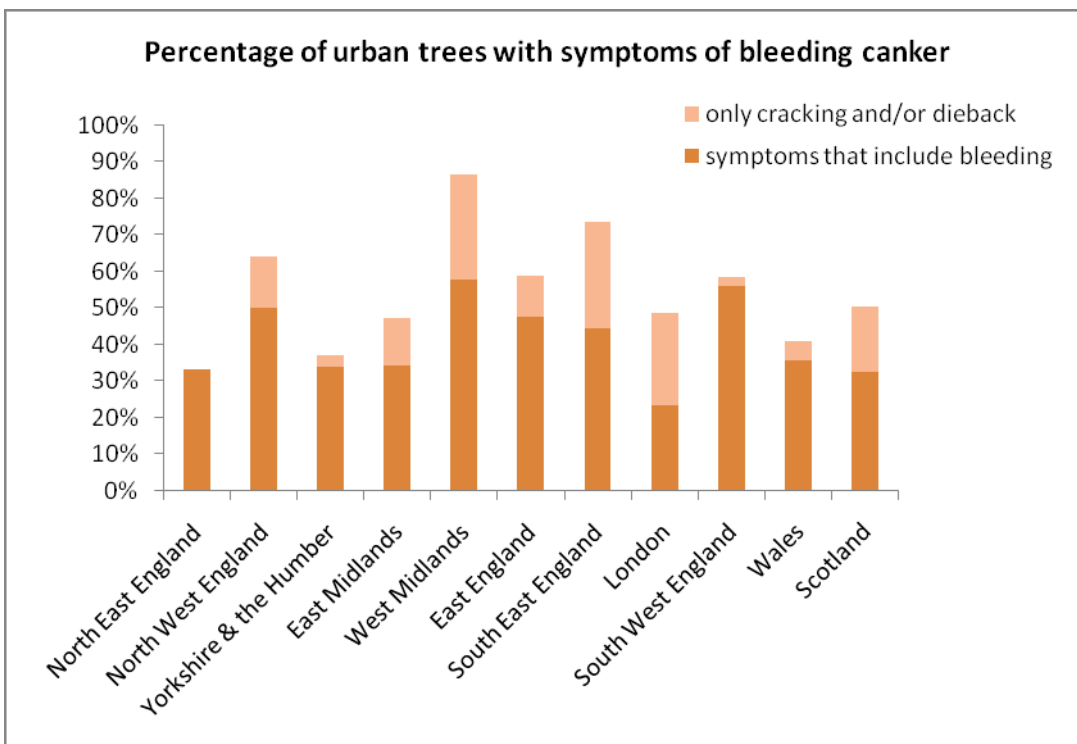


Figure 2b.



In the **rural** environment, a good spread of locations was achieved within and between regions (Table 4). The number of trees inspected at each location varied from 21 in hedgerows, to 294 in parkland. With the exception of hedgerows, golf courses and

churchyards, which all had small sample sizes, all other locations had trees showing symptoms of bleeding canker of >40%, with some closer to or over 50%. In summary it appears that no location in the rural environment is potentially free of bleeding canker and high (>40%) symptomatic levels were observed at most but not all locations .

Table 4. Location of Symptomatic Horse Chestnuts in the Rural Environment

REGION	Garden	Road side	Wood	Field	Avenue	Park	Hedge row	Golf course	Church yard	Other¹
North East England	3	11	3	9	18	2	0	0	0	0
North West England	13	3	1	5	15	16	0	0	0	1
Yorkshire & the Humber	5	6	6	8	0	13	1	0	0	0
East Midlands	3	7	10	5	8	0	0	13	0	0
West Midlands	1	5	3	3	15	10	0	1	0	0
East England	16	0	1	2	16	3	1	0	0	12
South East England	14	3	22	0	0	37	2	0	0	29
London	0	26	0	0	0	20	0	0	3	10
South West England	1	26	9	12	20	55	0	0	0	6
Wales	1	8	2	10	0	4	0	0	0	0
Scotland	5	11	15	6	0	5	0	0	0	1
No of Symptomatic Trees	62	106	72	60	92	165	4	14	3	53
No of Trees inspected	143	226	221	123	180	294	21	50	24	103
% of trees affected in each location category	43%	47%	33%	49%	51%	56%	19%	28%	13%	52%

¹ - other includes rural car parks, tracks leading up or around farms, canal bank and trees which could not be easily allocated a specific tree location

In the urban environment, there was a smaller range of location types (Table 5). The survey revealed garden and avenue trees had very high incidences of bleeding canker but the number of trees inspected at these locations was low. However, a large number of trees inspected were in parkland and roadside locations (365 and 482 respectively), and correspondingly high numbers of symptomatic trees were recorded.

Table 5 Location of Symptomatic Horse Chestnuts in the Urban Environment

NUMBER OF SYMPTOMATIC TREES PER LOCATION AND PER REGION										
REGION	Garden	Road side	Wood	Field	Avenue	Park	Hedge row	Golf Course	Church yard	Other¹
North East England	0	21	0	0	0	4	0	0	0	8
North West England	0	21	5	0	3	26	0	0	9	0
Yorkshire & the Humber	0	18	0	0	0	18	0	0	0	1
East Midlands	0	13	1	7	0	12	0	0	0	15
West Midlands	2	35	5	0	14	18	0	0	0	10
East England	0	35	2	0	13	22	0	0	0	0
South East England	6	24	5	0	26	42	1	0	0	25
London	10	21	0	0	0	9		0	1	9
South West England	0	36	0	0	4	16	0	0	0	14
Wales	0	5	1	0	7	18	0	0	1	13
Scotland	0	22	0	0	0	31	0	0	0	3
No of Symptomatic Trees	18	251	19	7	67	216	1	0	11	98
No of Trees inspected	22	482	69	12	91	365	1	0	35	167
% of trees affected in each location category	81%	52%	28%	58%	74%	59%	100%	0%	31%	59%

¹ - other includes = cemeteries, crematorium, car parks and trees which could not be easily allocated a specific tree location

Figure 2

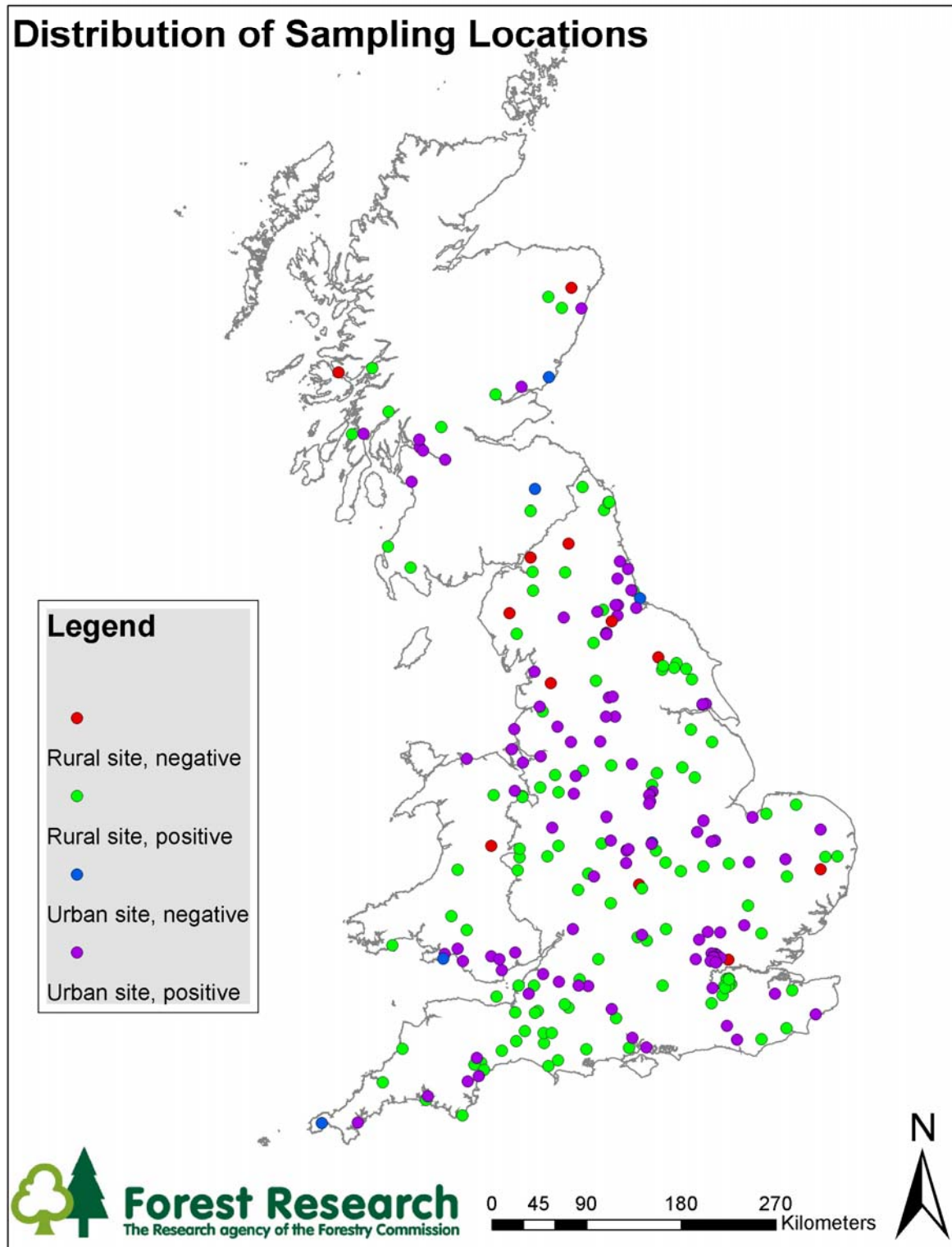


Figure 2 shows the location of sites, which were selected for survey, and whether they were positive or negative for symptoms of the disease. It indicates that bleeding canker appears to be present found throughout GB with positives in both the rural and the urban environment ranging from the south west of England (Cornwall) to the north east of Scotland (Aberdeenshire and the city of Aberdeen). From a brief consideration of regional disease levels, it looks appears there are some spatial differences (see Figure 2). Both the south and west parts of England had higher levels of bleeding canker in the urban environment, whether looking at all symptoms or just bleeds. However, differences in rural

populations at a regional level were less clear although there still appeared to be a higher incidence in both the south west and north west of England.

Overall, the spread of the bleeding canker disease of horse chestnut is much greater than was originally thought. However, it should be remembered that all these positive sites have yet to be inspected by THD to isolate the causal agent of bleeding canker and confirm that all symptoms observed on affected trees were caused by *Pseudomonas syringae* pv *aesculi*.

Conclusions

More than 2,500 trees were sampled in this survey and, despite their non-rigorous selection, it is clear they highlight a number of significant results and differences.

- Trees showing at least some of the symptoms typical of bleeding canker appear to be present in large numbers throughout GB.
- In both the urban and rural environments, symptoms of bleeding canker were found in all except one location.
- Stem bleeding and bark cracking were the most commonly observed symptoms.
- Bleeds, whether on the stem or on branches were observed in all regions in both the rural and the urban environment, although not all tree locations had trees with symptoms of bleeding.
- The levels of infection, if confirmed, vary across the regions.
- Potential Infection levels appears to be higher in the urban environment compared with the rural environment.
- The survey has given us an indication of the possible extent of *P. syringae* in GB (see Fig. 2)

Next Steps

- The data will be considered by THD for further analysis and comment.
- Forestry Commissions C & FS Plant Health Service will consider whether further investigation is necessary to determine whether those trees identified as symptomatic are indeed infected with *P. syringae*.
- Ultimately, advice to tree and woodland owners and managers on how best to minimise the impact of the disease will be published.

Acknowledgement

The Forestry Commission wishes to acknowledge the full co-operation and support given to its surveyors by woodland owners, their managers, local authorities and members of the public who were approached for permission to survey their land.

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Appendix I - Survey Team Details

Assessors from the Technical Services Unit (TSU) of Forest Research carried out the survey. These surveyors had undertaken training from THD staff in April 2007 prior to the commencement of the survey.

TSU Survey Team Members:

Wykeham Fieldstation:

Jake Thompson

Shobdon Fieldstation

Nick Fielding

Talybont Fieldstation

Justin Chappell

Alice Holt Fieldstation

Steve Coventry

Exeter Fieldstation

Barnaby Wylder

Fineshade Fieldstation

Steve Whall

John Lakey

Newton Fieldstation

Colin Smart

Ae Fieldstation

Harry Watson

Grateful thanks are also due to Liz Richardson of Fineshade Fieldstation who acted as survey co-ordinator.