

**Report on the Forestry Commission Woodland
Surveys 2004 to Assess the Level of Incidence
of *Phytophthora ramorum* in British Woodlands**

Summary

Between December 2003 and April 2004 the first major Forestry Commission *Phytophthora ramorum* woodland survey was carried out focusing on locations where rhododendron was found growing in admixture with trees. This consisted of inspections at 1217 high-risk sites across England, Scotland and Wales: 395 sites in England, 512 sites in Scotland and 310 sites in Wales. A further 131 sites have been surveyed in the lower risk areas in England and Scotland giving an overall total of 1348 survey sites. Sites were classified as either high risk or low risk based on climatic factors. A total of 335 samples were collected from symptomatic plants and sent to either Central Science Laboratory (CSL) in York or the Scottish Agricultural Science Agency (SASA) in Edinburgh for analysis. All samples tested were NEGATIVE for *P. ramorum*.

It is important to note that this does not prove that *P. ramorum* is not present at these locations: it merely indicates that *P. ramorum* was not found during the survey. The scale and size of the rhododendron in a great number of survey sites, and indeed the UK as a whole, makes the survey of individual plants extremely difficult. Due to the limited time that was available to the surveyor for each site (average 2-4 hrs) only a representative sample of the rhododendron that is present was actually surveyed and sampling was confined to material displaying visual symptoms similar to those expressed by plants infected by *P. ramorum*.

Nevertheless, it can be concluded that *P. ramorum*, if it is established in Britain's wider woodland environment, is at an extremely low level of incidence and that the national policy of containment and eradication at those sites where it has been found, remains fully justified.

NB: at the time of completion of this Report, surveys were still continuing in the low risk areas of England and Scotland and were due for completion within a matter of weeks.

Background

Phytophthora ramorum (the causal agent of the condition known as 'Sudden Oak Death') is a newly-identified (2001) fungal-like pathogen with the potential for infecting and killing numerous shrubs, ericaceous plants and tree species. There have been over 350 confirmed outbreaks of *P. ramorum* on plants – mainly rhododendron - in nurseries and garden centres across Great Britain since the first confirmed case was reported in April 2002. Infected rhododendrons and other host species have also been found at 34 parks and historic gardens around Britain.

The first confirmed case of this disease on an established tree in Britain was recorded in November 2003 on a single southern red oak (*Quercus falcata*) in a parkland setting in Sussex. This was the first record of an infected tree outside the USA. Over the following four weeks, a further four infected trees – all of different species – were identified at two historic gardens in Cornwall. At all three of these sites, *P. ramorum* had earlier been confirmed as being present and causing dieback on rhododendrons and several other ericaceous ornamental species. At the time of writing, in addition to the single *Q. falcata* in Sussex, a total of nine trees at the other two sites have been confirmed as infected with *P. ramorum*: a single holm oak (*Q. ilex*) at one and a sweet chestnut (*Castanea sativa*), a horse chestnut (*Aesculus hippocastanum*), a turkey oak (*Q. cerris*), two beech (*Fagus sylvatica*) and a further three holm oaks at the other. The sweet chestnut and the holm oaks are displaying only foliar infection while the others all have bark lesions. Statutory containment and eradication action is being carried out at all infected locations.

Elsewhere, two infected non-native red oaks (*Q. rubra*) were found at separate parkland locations in the Netherlands (Nov. 2003). As with the GB findings, infected rhododendrons had previously been found at these sites.

P. ramorum is potentially a very damaging disease to many species of trees and shrubs in Britain and it could have significant commercial and environmental consequences if it were to become widespread. The Forestry Commission is working closely with Defra and SEERAD, and is enforcing statutory emergency measures, first put in place in May 2002¹, aimed at containing and eradicating the disease wherever it is detected in order to prevent it becoming a common occurrence in trees and woodlands in Britain. These measures were amended in November 2002², when they were extended throughout the European Union. These have recently been reviewed by the European Commission and are due to be strengthened later in the summer.

In developing disease management policy it is essential to determine the status of the organism within the area to be regulated. Defra and SEERAD have been carrying out intensive monitoring of nurseries, garden centres, established public gardens and some nearby woodlands since the first confirmed finding in Great Britain in a *Viburnum* in April 2002. The Forestry Commission revisited sites where an unrelated but not fully understood phenomenon known as 'oak decline' is known to occur and we have also examined susceptible tree species wherever they have been found close to infected nurseries, garden centres or garden sites. No evidence of infected trees was found. However, following the confirmation of the infected trees in November/December 2003, we identified a need to survey more widely those woodlands where rhododendron, known to be the principal source of inoculum, is growing in admixture with trees. The information from this and future surveys will be used to inform national policy on measures to manage this disease.

Objective of the Survey

To obtain an understanding on the distribution of the fungal pathogen *P. ramorum* on rhododendron growing in admixture with trees in woodland across Britain in order to inform policy development regarding eradication and containment or, alternatively, management of this potentially devastating disease.

Timetable

The Forestry Commission survey of the high-risk zone started in late December 2003 and was completed by 31 March 2004. The Forestry Commission set a three-month timetable in order to attain a high level of surveying in a reasonably short period of time. The High Risk Zone is shown on the CLIMEX data map in appendix 3. This was developed by CSL and shows a climatic comparison between the locations infected by *P. ramorum* in Oregon and the long-term average (1961-2000) data in Great Britain. Surveys were concentrated where there is a 60% or greater match (i.e. areas other than those shaded blue on the map). Surveys are still continuing in the low risk zone at a much lower density.

¹ The Plant Health (*Phytophthora ramorum*)(England) Order 2002 (SI 2002 No, 1299); The Plant Health (*Phytophthora ramorum*)(Wales) Order 2002 (SI 2002 No. 1350 (W.130)); The Plant Health (*Phytophthora ramorum*)(Scotland) Order 2002 (SI 2002 No. 223); The Plant Health (Forestry)(*Phytophthora ramorum*)(Great Britain) Order 2002 (SI 2002 No. 1478).

² The Plant Health (*Phytophthora ramorum*)(England) (No.2) Order 2002 (SI 2002 No, 2573); The Plant Health (*Phytophthora ramorum*)(Wales) (No. 2) Order 2002 (SI 2002 No. 2762 (W.263)); The Plant Health (*Phytophthora ramorum*)(Scotland) (No. 2) Order 2002 (SI 2002 No. 483); The Plant Health (Forestry)(*Phytophthora ramorum*)(Great Britain) (No.2) Order 2002 (SI 2002 No. 2589).

Survey Data Summary

Table 1 summarises the results of the survey of all high risk areas, which were completed by 31 March, as well as those low risk areas that had been completed by the same date.

Table 1

Country	Number of High Risk Survey Sites*	Number of Sites with No Rhododendron	Total Number of High Risk Sites Surveyed	Number of Low Risk Survey Sites**	Total Number of Samples Taken ***	Results Returned Positive For <i>P. ramorum</i>
England	395	70	325	117	147	0
Scotland	512	199	313	14	104	0
Wales	310	41	269	N/A	84	0
GB Total	1217	310	907	131	335	0

*This is total number of survey sites (each plot square can include 1, 2, 3 or 4 survey sites) including those where no rhododendron was found.

**These surveys are continuing and data will be compiled and released when completed in May 2004

*** Could be more than one per site

A spreadsheet of the detailed findings per site has been compiled. Due to its size it is not included in this report but is available on request.

Conclusion

It is not possible to conclude from any survey of this type whether a disease is present or not. However, by careful targeting of sites and focusing sampling on symptomatic plants known to be most susceptible to infection and which readily demonstrate visual symptoms, it is possible to draw conclusions with reasonable confidence. In this, the first such survey of its kind aimed at detecting this disease in the woodland environment, 1217 sites believed to be at high risk and 131 sites classed as lower risk have been surveyed in accordance with a protocol reviewed and endorsed by Biomathematics and Statistics Scotland, an independent and acknowledged body in this field. No evidence of infection has been found. While not primarily aimed at detecting *P. ramorum*, other ongoing surveys such as the annual Forest Condition survey³, first carried out in 1987 to detect changes in the condition of Britain's forest trees, have not recorded any symptoms similar to *P. ramorum*. The Disease Diagnostic Advisory

³ Forest Condition 2002, Information Note 51, Forestry Commission September 2003

Service, which is operated by Forest Research and which is used as an early warning system to detect new diseases, has not had any cases referred to it where *P. ramorum* was identified.

We have therefore concluded that *P. ramorum*, if it is present in the wider woodland environment, is not widely present and can be considered as not established. A policy of containment and eradication at all sites where infection is identified is therefore fully justified and should be maintained.

Next Steps

The Forestry Commission plans to maintain an ongoing programme of woodland surveys in 2004 – 05 and beyond. In addition to visual surveys and sampling symptomatic plants, we plan also to sample water courses within woodland areas using established baiting techniques. Results of future surveys will be published on the FC website at www.forestry.gov.uk/pramorom. Defra and SEERAD will continue to carry out complementary surveys in nurseries, gardens and the wider environment. In addition, Defra will also survey heathland areas where vaccinium plants, which are known to be susceptible from laboratory trials, are abundant.

Acknowledgement

The Forestry Commission wishes to acknowledge the full co-operation and support given to its surveyors by every woodland owner or manager who was approached for permission to survey their land as part of this survey. We were impressed by the level of interest shown by many who were keen to know more about the disease and the outcome of our work.

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6 May 2004

Appendix 1: Survey Protocol:

By surveying appropriate woodlands and inspecting the trees and rhododendron growing in those woodlands for presence of absence of the disease *P.ramorum*.

On-site assessment will be performed by trained assessors. If there do not appear to be any symptoms of the disease on either the trees or rhododendron, the site is recorded as being free from the disease i.e. a negative result.

If suspect bushes or trees are observed at a site, foliar (rhododendron) or bark (trees) samples will be sent for laboratory analysis. A site will only be confirmed positive if *P.ramorum* is isolated in the laboratory.

The Forestry Commission want to know what proportion of woodlands in mix with rhododendron are positive for *P.ramorum*.

• Selection of the SITES to be sampled

Surveying for the pathogen *P. ramorum* will be in woodland in mixture with rhododendron within the area of 60% or greater climatic matching between Britain and Oregon as described by the CLIMEX model supplied by R. Baker of Central Science Laboratory. Control plots will also be placed in the lower risk area for comparative purposes.

Resources will not allow all woodlands in mixture with rhododendron to be visited. A sampling scheme is therefore required.

1. Each 10 x 10 km square in the higher-risk area will be considered in turn.
2. Maps of the 10 x 10 km square will be inspected in the office by local foresters for all woodlands (public and private) in mix with rhododendron;
3. If local knowledge says there are no woodlands in mix with rhododendron then move to the next square;
4. If woodland in mix with rhododendron is thought to occur within the 10 x 10 km square, then that square is selected for surveying;
5. Place a plot in a suitable woodland in mix with rhododendron nearest to the SW corner;
6. A woodland selected for surveying should be 2ha or larger;
7. The woodland may be owned by FE, Private (Grant Aided), or Private (Other; i.e not grant aided). Select the woodland regardless of ownership
8. If there are problems contacting the owner of a selected site, move onto the next available woodland moving out in a NE direction;
9. The general rule will be 1 site per 10 x 10 km square provided it has woodland in mix with rhododendron > 2 ha:
10. If > 2,500 ha of woodland, then do 2 sample plots. Select the 2nd plot as woodland in mix with rhododendron > 2 ha nearest to the centre of the 10km square;
11. If > 5,000 ha, then do 4 sample plots; one in each of the four 5 x 5 km grid squares which make up the 10 x 10 km square;
12. If during the course of the survey work, it becomes apparent that the disease is more common on a particular site type, the selection of woodland to be surveyed will be amended accordingly and due records kept of when and in what way the site selection was modified:

13. FC Woodland Officers should confirm and record that access to sites has been assured. In order to test the hypothesis that the disease is more common in the 'higher-risk' areas, survey plots will also be placed in the 'lower-risk' area (<60% climatic match as described by the CLIMEX model), but at a lower sampling intensity. The selection of suitable sites will be as described above but the frequency of samples on the ground will be approximately 5 to 10% i.e. between 5 or 10 randomly located 10 x 10 km square within a 100 km grid square.

- **Carrying out the survey of a select site:**

Having selected the site, the objective is to determine if P.ramorum is present or not, therefore inspection should be directed to areas thought most likely to harbour the disease.

1. Inspections will be limited to a max. of 10 ha at each site;
2. There should be a general walk through the area concentrating on rides, compartment edge and watercourses but not ignoring areas within the centre of the woodland;
3. Samples should be taken from suspicious shrubs and sent to CS ;
4. Samples should be taken from suspicious trees and sent to FR Alice Holt as well as informing Head of Plant Health;
5. A standard *pro forma* will be completed for all sites visited (Appendix 2). The form will be used to record basic environmental variables (grid reference; height above sea level) which can be linked to existing Forest Research models to predict certain climatic variable for the site (e.g. rainfall; heatsum). The same form will also allow recording of conditions within the site – density and size of rhododendron and trees – and specifically conditions surrounding samples bushes or trees. These data may be used in any future modification to the manner in which woodlands are selected and surveyed.
6. All survey teams will be visited periodically by the over-all co-ordinator to ensure that sampling is being equally performed at all sites.
7. Towards the end of the survey work, survey teams will be transferred across territories and 'blind-tested' in an attempt to assess the repeatability of the survey procedure within a site, across survey teams.

- **When taking a sample**

1. Take a digital photograph of the suspect bush or tree;
2. Label;
3. Take a GPS reading or describe by use of a map and reference points on the ground how to find the bush or tree again.
4. Enter site details on the survey site *pro forma* (Appendix 2).

Anticipated additional sampling:

To make the data from the general survey more robust, and also to give a better understanding on the distribution of the disease locally, further survey work will be carried out contingent on findings from the more general survey:

- If a woodland is found to be positive for *P. ramorum* in the general survey, survey teams will return to that 10 km square and perform a more intensive survey of woodlands within that square and the 10 km squares immediately surrounding it. These extra data points will provide more information on whether the disease is clustered or not. This practice may have to be reviewed if indications are that the disease is widespread and is present in most 10 km squares.

- In addition, several 10 km squares which previously provided a negative result will be selected for further intensive survey in an attempt to quantify the likelihood of false negatives from the more general survey.
- Following seminars to be held in early January 2004, it is anticipated that there will be an increase in the general awareness of the symptoms of this disease on rhododendron and trees. Survey teams are likely to be asked to inspect suspect woodlands as they approach a particular area. Such surveys will be in addition to the woodland selected as part of the general survey work described above. However, as with the general survey work, if a site identified by a member of the public or forestry profession is found to be positive, more intensive sampling will follow as described above.
- More intensive survey work will be carried out of woodland in mixture with rhododendron in the vicinity of the 34 sites of established plantings already found to harbour the disease. At the time of writing it is unsure if this survey work will be carried out by FC staff or Plant Health Seed Inspectorate (PHSI) staff. The data collected will however be combined with the data collected in the general survey outlined here and additional survey work described above in forming a conclusion on how widespread the disease is in Britain.
- It is anticipated that PHSI will carry out further random checks of parks and historic gardens with more intensive survey work of surrounding woodlands (as described above) to follow if an inspection proves positive. These data will again be combined with data from the other survey types described above in forming a conclusion on how widespread the disease amongst trees and rhododendron in Britain.
- It is acknowledged that the data collected from the general survey will have to be interpreted with care. Since time does not allow the detailed inspection of each rhododendron bush or tree at each site there remains the possibility of recording *false* negatives for the site. Equally the site may not be representative of the 10-km square so again, a negative conclusion at the site visited may be a *false* negative for the 10km square as a whole.
- It *will not* be assumed that a negative assessment of a woodland within a 10 km square means the whole of that 10 km square is free from the disease, merely that the survey team were not able to identify infected rhododendron bushes or trees in the randomly selected woodland representing that 10 km square.
- The data collected from the general survey in combination with the anticipated additional survey work outlined above will however give some indication on how widespread the disease is across Britain. The data *will give* an indicative 'snapshot' of the state of the disease in Britain at this time as well as some data on whether the disease is clustered or not. A review of the data in April 2004 will consider the need for further survey work at either a national or local level.

Written by:

Dr Steve J. Lee, Forestry Commission, Date: 10 Dec. 03

Incorporating comments from: Andy Peace Forest Research,

Also incorporating comments from: David Elston Biomathematics and Statistics Scotland (BioSS)

Recording the activities associated with sampling woodlands for presence of *Phytophthora ramorum*

Site Name: _____ Grid Square: (e.g NT01/ A, B, C or D) ___ ___ ___ / ___
(A = 1st plot; B= 2nd plot etc)

Date : ___ / ___ / ___ (DD/MM/YY) Grid Ref/GPS reading (entrance): _____
(Mark map to indicate location)

Sampling Type: (Intensive, around confirmed outbreaks (I); Appeal by a local owner (A) or the more general 10 km. sq. inspection of woodland in mixture with Rhododendron (W)

Owner or Agent (Name): _____ Address: 1. _____ Post Code: _____
 2. _____
 3. _____

Tel: _____ Fax: _____ E-mail: _____

Samples taken by: _____ Officer Mobile 'phone no: _____

General description of site visited (tick): _____ Approx. Total area _____

Trees (1, 2, 3, 4, or 5)		_____	Rhododendron		_____
1	Woodland, thinned	_____	Abundant (A)	_____	_____
2	Woodland, unthinned		Occasional (O)		
3	Parkland - occasional trees		None (N)		
4	Parkland – rare trees		Species	_____	
5	Private garden	_____	<i>R. ponticum</i> (R) Other (O)	_____	_____
6	Other		Known to be infected prior to visit? (Y/N)	_____	_____
			Vaccinium present on site (Y/N)	_____	_____

Topography of the site: Level (L) gentle slope (G); steep slope (S); valley (V) _____

Approx. height above sea level _____ m

Trees at the site:

Tree Species (use standard abbreviation)	Common (C); Occasional (O) Rare (R)	Approx. Age
1		
2		
3		
4		
5		

Rhododendron at the site: (size, condition)

Size: Small (SM); Large (LG); Variable (V) Recently Cut (RC)	Condition: Managed (MG); Not Managed (NM)
1	
2	
3	

Other site details:

.....

Details of sample taken:

Sample Number: Grid sq. descriptor + sample number e.g. NT01/A / 01	Tree species or Rhododendron (R)	Diam. (cm) - trees only	Tree/Rhodo. Mix 1-5/ A,O,N	GPS (if possible) plus mark location on map	Office use only:
___ / ___ / ___				-----	

Foliar sample: Sample sent to (C, F, O) ___

CSL (C) or FRA (F) or Other (O)

Further sampling on return visits to site now known to be +ve for *P. ramorum*

Water sample taken: GPS: _____ Sample sent to: (C, F, O) ___

CSL (C) or FRA (F) or Other (O)

Soil sample taken: GPS: _____ Sample sent to (C, F, O) ___

CSL (C) or FRA (F) or Other (O)

All clothing and Equipment Disinfected before leaving site (Y/N or tick)

Signed

PLEASE NOTE:

Head of Plant Health should be informed immediately if there is thought to be a high probability that one or more of the trees sampled could be infected with *P. ramorum*. Contact details are:

Roddie Burgess 0131 314 6401 (Direct dial, Silvan House)
 07831 843 985 (Mobile)

Appendix 2: Survey Team Details:

Trained Forestry Commission assessors carried out all *P ramorum* woodland surveys. A total of 32 direct FRA Technical Support Unit staff were used during the survey period. All staff were either trained at an outbreak site during the training seminar on the 2nd December 2003 by both Forest Research and Defra staff or at the Scotland training seminar held in Ardrishaig⁴ on the 12th and 13th January 2004 held by Plant Health staff.

List of Survey Team Members:

TSU Teams South (England and Wales)

Norman Day
Kate Harris
Ralph Nickerson
Steve Coventry
Doug Nisbet
Chris Jones
Trish Jackson
Rachel Sparks
David Evans
Barnaby Wylder
Brian Hanwell
Richard Nicoll
Dave West
Liz Richardson
Tony Reeves
Alan Ockenden
Lee Cooper
Bill Riddick
Alex Hill
Tony Price

TSU Teams North (Scotland)

Kate Fielding
Martin Mackinnon
Colin Gordon
Dave Anderson
David Watterson
James Duff
Harry Watson
Len Thornton
Alaistair MacLeod
Fraser McBirnie
Stuart McBirnie
David Tracy
James Wilson

⁴ Ardrishaig was chosen as an appropriate location for training due to the nature of the woodland cover and abundance of rhododendron. There has been no evidence of *P. ramorum* either at Ardrishaig or in its vicinity

Appendix 3: CLIMEX map giving an indication of the climate overlap between GB and Oregon (USA) © Richard Baker, CSL

