Imperial College
London

Review of Joint Inter-Departmental Emergency Programme to Contain and Eradicate *Phytophthora ramorum* and *Phytophthora kernoviae.*

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October 2009

Executive Summary

1. Introduction

This report is a review of the inter departmental emergency programme of work to contain and eradicate two pathogens, *Phytophthora ramorum (Pr)* and *Phytophthora kernoviae (Pk),* overseen by Defra and the Forestry Commission (FC). It covers the time period from the first discovery of *Pr* in Great Britain (GB) in February 2002, to the close of this programme in April 2009.

Responding to the threat posed from *Pr* and *Pk* has posed an unprecedented challenge to the authorities responsible for plant and tree health in GB. Several of the characteristics of *Pr* and *Pk* have made for a unique threat to which Defra, the FC and the devolved authorities of Scotland and Wales have had to respond. This includes the diversity of habitats in which they have been found - woodland, historic gardens, heathland as well as plant nurseries; the large host range, and the initial high levels of scientific uncertainty over the nature of the pathogens and their impacts. Intervention is further complicated by infected sites having a mixture of public and private landownership, and differing levels of public access. Thus, *Pr* and *Pk* have shown the ability to jump not only habitat types and species boundaries, but also agency responsibility boundaries, exposing vulnerabilities in terms of the way in which authorities can, and should, react.

In England and Wales there have been a total of 901 outbreaks of *Pr* between April 2002 and June 2009. 261 of the outbreaks have been in the wider environment with 85 of these now eradicated. At retail and productions sites there have been 640 outbreaks with 541 of these now eradicated. In the case of *Pk*, between October 2003 and June 2009 in England and Wales there have been a total of 74 outbreaks Five of these have been on retail and production sites, with four eradicated. In the wider environment, one of the outbreaks has been eradicated, with 68 on-going. Since 2002 in Scotland there have been 43 outbreaks at nurseries and garden centre sites, and three at newly landscaped sites, of *Pr.* There are currently no ongoing nursery or garden centre

outbreaks in Scotland. At established gardens since 2007 there have been 14 outbreaks of *Pr* and two outbreaks of *Pk*.

This report seeks to provide a balanced review of the emergency programme, incorporating the concerns, criticisms and suggestions for future policy, of those involved with designing and implementing policy for *Pr/Pk* and those involved with managing outbreaks on the ground. A review of the emergency programme response to *Pr*/*Pk* is not only important for improving the future management of *Pr*/Pk*,* but it is believed it will have wider significance in the future, in providing an important reference point for managing new plant and tree health risks.

The authors carried out in-depth structured interviews with 20 individuals who had played a key role in implementing the emergency programme or who were stakeholders involved with managing *Pr/Pk* outbreaks. An on-line questionnaire was also implemented to obtain the views of a wider group of people who had been involved with *Pr/Pk.* The views of these 49 respondents (22 stakeholders and 27 involved with management) are also incorporated into this review. This report is also informed by a review of the scientific and literature on *Pr/Pk* including Defra and FC publications, internal documents and the Programme Board minutes. This report identifies both best practice, and the lessons that should be learnt from this experience, in order to inform future work.

2. Origins, timing and points of entry into the management of *Pr/Pk*

This report examines the origins, timing and points of entry into the management of *Pr/Pk*. In terms of the initial response to the *Pr* outbreak, it concludes that the authorities acted as rapidly as could reasonably be expected, both in acknowledging the risk and in putting together a series of PRAs. The limiting factor in the speed of the response was commonly observed as the uncertainties about the impact and management of the disease in the UK, due to the low level of scientific information available. This episode illustrates the importance of international scientific connections between the UK and the USA, and the capacity to share information about future threats in good time. This allowed the link to be made between the causal agent of 'Sudden Oak Death' in the USA, with a new *Phytophthora* that was a potential threat in Europe, and that had first been identified infecting *Rhododendron* and *Viburnum* in Germany, and *Rhododendron* in the Netherlands, in 1993. However, these Dutch and German observations were not shared with the international community at the time and this meant that there was almost 10 years for *Pr* to circulate in the nursery trade. In addition to potentially allowing the wider spread of *Pr*, this is likely to have increased the risk to the trade itself, within which the threat had been established on the continent.

Following surveys carried out for Pr, a new *Phytophthora* species was isolated in Cornwall in October 2003. This new species was formally named as *Phytophthora kernoviae (Pk)* by Brasier *et al* (2005). Our research suggests that the authorities acted as rapidly as could reasonably be expected. Again, resource levels were identified as a limiting factor. However it was observed that lessons had been learnt in dealing with *Pr.* For the UK, *Pk* is considered to be a recent exotic introduction. This raises a number of questions about the ability of the UK to identify 'new', 'unknown' or 'un-listed' pathogens. Indeed, despite efficient responses as described here by the responsible authorities, by the time *Pr* was identified as a problem, and found in the UK, it was already too late in that it had moved out of the nursery trade, where it is easier to contain, to the wider environment.

3. Effectiveness of the Programme Board

The 'Programme Board' met 20 times between February 2003 and February 2009. There were differing views on its effectiveness: It was commonly stated that its main strength was that the key departmental players were involved from the early stages. Representatives from PHD, PPHSI, CSL, FC and SEERAD attended throughout. This allowed for the effective co-ordination between responsible parties. The creation of 'sub-groups' allowed for the effective involvement of stakeholders, the small size of the Board allowed rapid feedback from the sub-groups to the main Board, and it brought together considerable scientific and technical expertise.

The weaknesses identified included the fact that the Programme did not have its own programme budget, but co-ordinated activities/funds across all the government bodies and devolved authorities. There was criticism that the decision-making process was slow and too protracted due to the high number of people involved. The suggestion was made that the structures should be reviewed at least once a year to ascertain whether each working group was fulfilling its purpose. There was concern that the link up between all the sub-groups and the programme board was not always that strong. Others thought that the membership of the programme board was not inclusive enough. Whilst groups such as the National Trust and the RHS were asked to join, there is a question of whether they should have been more strongly encouraged, as they were not immediately forthcoming. In particular there was a failure to engage the conservation organisations with the potential threat to heathland ecosystems from *Pr/Pk* until findings were found on *Vaccinium myrtillus.* Although the risk was identified early on it was not seen as a priority by conservation interests. Criticisms have been made that several key scientists working on *Pr /Pk* in FR and CSL were not included as full members of the board from the beginning and did not attend on a regular basis. Plant health is a devolved matter in Northern Ireland (NI), Wales and Scotland. It is suggested that better communication and exchange of information with NI authorities would have been beneficial. It is strongly suggested that Wales do have a place on the

new Board. Connections with Scotland were considered good with representatives of SEERAD on the Board from the beginning.

4. The use of science and the development of the policy evidence base

The review also examined the use of science and the development of the policy evidence base. It is considered that the response has been appropriate and timely: The initial PRAs were conducted rapidly, framing the problem accurately and have subsequently been developed as new information arises. High quality research has been carried out on the main issues. Given more funding, research into potential management approaches in heathlands could have been undertaken *before* the infection was realised, perhaps reducing the current state of uncertainty. Developments in diagnostic tests have been important for the efficient carrying out of inspector's duties, proved cost-effective and speeded up the diagnosis process considerably.

Both *Pr* and *Pk* represent a new cross habitat challenge for both management and research. As such the pathogens did not fall exclusively into either of the traditional domains of CSL or FR. At an early point, the decision was made that since *Rhododendrons* are large ornamental shrubs, they should be dealt with entirely by CSL, and that FR should not conduct research into woodland *Rhododendron*. This decision was apparently made with the intention of clarifying funding, but failed to take into account the areas of expertise of each organisation, and the complex nature of the problem. From an objective viewpoint this decision seems both artificial and inappropriate. Whilst CSL have adapted to their new research problems admirably, performing invaluable research, some of our respondents have argued that it is appropriate to allocate research to those *best qualified to address specific questions*, rather than according to an arbitrary species specific delineation. It seems unlikely that a more flexible approach to the allocation of research would have been problematic.

As the outbreak spreads to heathlands, the problem widens. Neither CSL nor FR has existing habitat specific expertise to address the problem. Some respondents argued that a full reappraisal of the organisation of research into cross-habitat threats is required. It is possible for scientists from different research organisations to both compete for funding and subsequently work co-operatively.

5. The impact and effectiveness of the measures taken on the ground

The review then examines the impact and effectiveness of the measures taken on the ground**.** The first measure was the extensive survey work carried out by PHSI and the FC that led to the first findings of the diseases. However, there was concern that the two surveillance programmes were not fully co-ordinated between the two agencies. It is thus recommended that a single database is set up for the new programme.

The second measure considered was the inspection of cargo at ports. The risk of disease introduction from timber imports is considered extremely low. On the other hand, it was recognised very quickly that there was a problem with infected plant material coming into the UK from the continent and inspections at the dockside were carried out. Relatively draconian measures were taken, with material that was not supported with the correct plant passport paperwork being sent back. However, no infected material was actually found during the port inspections of material entering from other Member States. Nevertheless, it is still believed by many that infected material continues to enter the UK from the continent. Concerns are raised about how effective these port inspections really are given the huge quantities of material involved, and the use of fungicides which can suppress symptoms. Import controls, are therefore inadequate in themselves, making the inspection programme after unloading essential. However, the positive impact of these measures has been that European suppliers became more careful with the material being exported, as well as UK growers being more careful with their sourcing. It is seen to be a valuable deterrent, and an effective way of raising awareness.

The Plant Health (*Phytophthora kernovii* Management Zone) (England) Order 2004 (Anon, 2004a) was introduced in December 2004 and it gave Defra and FC specific powers within this defined area of Cornwall where *Pk* was first identified. The Order prohibited the removal of all host plants out of the Zone without permission. The Zone was set up to deal with the particular nature of the incidence of the disease in this particular area. It was not found on nurseries or large scale landowner plots, but on a relatively large number of houses [c1600 landowners/occupiers] and it would have been extremely difficult to issue individual notices to each of these properties separately. Thus, the Zone was introduced whereby all the controls were standard for everyone. In these terms it was an effective method. The Zone also gave powers to close footpaths temporarily and this was considered very important in that area, facilitating the rapid removal of high risk infection close to footpaths. It was considered difficult to police effectively, though, and perceived to be in need of more resources.

Both *Pr and Pk* are notifiable plant pathogens and so there is a legal requirement to notify PHSI if an outbreak is known or suspected on host species. A policy of disease eradication is in place for nurseries and retail premises and this regime is commonly seen as one of the most effective aspects of the Programme measures. Taking infected plants out of circulation before they can be planted out in the wider environment is a critical step in preventing further spread. Not only did this regime result in the removal of many diseased plants, it also helped to raise awareness back up the distribution chain. The effectiveness of these measures is reliant on co-operation of the industry, which generally, with notable exceptions, has been good. Inspectors have experienced accusations of alarmism or denial over the scale of the problem from nursery owners. However, there is a long-standing history of interaction between nurseries and Defra/PHSI and a long-term

awareness and experience of pest and disease issues that has contributed to easier management. This compares favourably with other environments in which *Pr/Pk* has been found.

Nevertheless, new infections are still being identified. It is reported that regular interceptions are still being made on imported plants. The level of nearly one percent findings is still a concern, and so there is consideration of whether these measures ought to be strengthened to reduce below one per cent. There are also questions over the frequency of inspections. However, the economic impact on horticultural commercial sector of these measures is an important consideration. It is understood that the actions at nurseries for removing and destroying plants will be reviewed by the Commission.

Species/hybrids of *Camellia, Rhododendron* (other than *R. simsii* which has been shown to be resistant to *P. ramorum* in tests) and *Viburnum* are now subject to plant passporting requirements to the point of final retail sale. The conditions of the passport are that material originates in areas where *Pr* is known not to occur or where there have been no signs of the pathogen at the place of production. In cases where signs of the pathogen have been found, appropriate procedures for eradication must have been implemented. The total number of *Pr* passporting infringements has fallen substantially from 2003 to 2007. The number of these *Pr* findings that were on passported material is small, compared to those found on non-passported material. The majority of *Pr* findings are on plants where the plant passport is missing. Plant passporting is seen by many as the only realistic prospect for bringing down levels of disease in traded nursery stock. Within the UK, the authorities have given it a high priority, although in the wider EU, the effectiveness is seen to be more variable depending on the priority given to it by the inspection services. There is a question over whether more genera, other than the current three that are passported, should be given that the host lists for both pathogens is extensive.

Questions remain over the use of fungicides; the use of anti-*Phytophthora* fungicides on plants held under Statutory Notice is prohibited. It is also *recommended* that trading arrangements with suppliers stipulate a 6 week prohibition on the use of anti-*Phytophthora* fungicides on known host plants prior to despatch, other than where such fungicides are required to suppress other *Phytophthora* species. Nevertheless, fears have been articulated in this survey, that fungicide use is masking symptoms and allowing infected plants to evade visual detection during import inspections or during monitoring. According to Sansford and Woodhall (2007), two studies (Shishkoff, 2005; Turner *et al,* 2006) indicate this may not be a major factor, but confirmatory evidence is still not available.

It is considered that the management of the diseases in the natural and semi-natural environment (woodland and historic gardens) has been much more difficult in comparison to the nurseries, in

terms of pinpointing where the disease is, knowing what the susceptible plants are and taking correct action. In addition to knowing much less about what the hosts were, it was often the case that those responsible were coming to the infections in the natural environment much later when they were already quite intense infections, particularly in Cornwall. Thus a move to the idea of eradication rather than containment seemed to be the only way forward there.

Clearance of *R. ponticum* has been the main management mechanism on infected woodland sites and is commonly seen as key to the management of the disease. It is also seen to have other positive consequences as *R. ponticum* is commonly viewed an invasive (non-native) species and clearance can improve access to land for the public. In the future, widespread clearance of *R. ponticum* will necessitate decisions about how the cleared land will be managed and will inevitably lead to changes in land use. Funding was for the clearance of *R. ponticum* on land that was *infected*. The rationale was to remove the infected *R. ponticum* and any other *R. ponticum* on that site to create, in effect, a host free buffer zone around that site. The areas that need to be cleared, given limited resources, were prioritised using a risk matrix. This was based on focusing on minimising the potential for distance spread. However this has meant that larger woodland and non-woodland sites that were infected were being left and were, in effect, acting as reservoirs of inoculum. Whilst it was believed that it was correct to use this rationale to focus on the highest priority sites, it is also argued that there would've been a strong rationale to continue an active programme of clearance on the larger sites that were infected but that posed a lower risk of distance spread. Obviously this would require considerably more financial resources.

Problems emerged about the type of land that can be cleared using the existing WIGS funding mechanisms that could only be used on woodland, and not open land without tree cover. (Gardens can be cleared under that scheme if the percentage tree cover is high enough). This has contributed to the criticism made that clearance has been in a rather 'patchwork' manner. There is a need for a more joined-up, co-ordinated approach to *R. ponticum* clearance. The other criticism identified of the clearance programme is that no pro-active clearance of *R. ponticum* (i.e. on uninfected sites) was carried out. It is understood that this will occur in the new programme.

The third type of habitat where *Pr*/*Pk* has had significant impacts is in public and private 'historic' gardens. The majority of these are in Cornwall, and a sizeable proportion belongs to the National Trust. These traditional Cornish Spring gardens, whose main attractions are the early spring flowers of *Rhododendron*, *Magnolias*, and *Azaleas*, have been badly affected. This is posing a risk to the Cornish tourist economy. There is general consensus that the management of the disease in historic gardens has been much more of a challenge than in the nurseries or in woodland, due to a combination of physical, environmental and social /cultural factors. The initial Defra policy of eradication created difficulties and was not found to be practicable in the end. Indeed, inspectors found resistance to plants and trees being taken out of the gardens, because

in many cases, especially in Cornwall, the main susceptible hosts of *Pr/Pk* are the main reason for the gardens being there.

A shift to containment through the issuing of statutory containment notices ensued. This acknowledged that any action taken might impact on a local tourist income stream and that a balance had to be struck between that concern and the effective management of the *Pr/Pk* risk. The intention was to minimise the risk of spread of disease from the site. Rather than an insistence that all infected plants were removed at once, the problem was dealt with on a case by case basis at different gardens.

It was observed that the success of such measures depended on how quickly the action was taken, and the scale of the outbreak. There have been benefits of this more flexible approach including improved relations between garden owners and PHSI/FC. However, this approach had been contentious with accusations that not enough has been done to ensure that the gardens don't act as a source of inoculum for the wider environment. Some gardens are not removing infected plants. There is a concern with the risk posed by large numbers of visitors to these public gardens, many of whom will visit more than one garden on their trip or visit the wider countryside. Whilst clearly there are many benefits to having a flexible approach that can take into account the nature of the risk at specific gardens, it might be valuable to have a system in place to verify that the process is fair and to clarify the criteria in which decisions are being made. Therefore it is suggested that garden management plans should be developed.

There is clearly a tension between the desire for garden owners to not have their visitor numbers reduced by providing too much 'alarmist' information about *Pr/Pk,* and on the other hand being able to reap the benefits from providing more information to the public so that they modify their behaviour and reduce the risk of spreading *Pr/Pk.* In National Trust gardens, notices have been placed on notice boards and retail sales areas informing the public about the presence of *Pr/Pk* but these are rather low key. At the Lost Gardens of Heligan, a more visible attempt has been made to communicate with the public, although some of the signage has been made necessary through management practices, such as the raising of the canopy of a *Rhododendron spp.* and the need to stop the public wandering underneath. A similar tension arises for the suggestion that physical biosecurity measures such as installing foot dips or pads of fungicide at known infected gardens. However, recent research by the authors of this report (forthcoming) at Imperial College of 500 garden visitors to NT gardens in Devon and Cornwall asked about the public's willingness to change behaviour to manage *Pr.* This research has indicated that the concerns of the gardens in terms of impact on garden visitors may be unfounded as it shows potential adaptability of garden visitors to new biosecurity measures.

Questions have arisen about the future of these gardens, and what the long-term impact of the disease will be. Many garden owners are hoping to manage the disease through actions that include changing the local environment of the garden. It has been suggested that a radical re-design of the garden might be necessary. However, any shift away from the 'traditional Cornish Spring garden' is likely to have major impacts on the Cornish economy and many garden owners are resisting suggestions made to consider the longer-term.

6. The role of stakeholders and the public

The report considers the involvement of stakeholders and the public, and it is widely accepted that their engagement is critical in the management of *Pr/Pk* in GB. Stakeholders have been formally involved in the *Pr/Pk* programme through stakeholder meetings and through involvement in the industry liaison group. Whilst communications were perceived as generally good, some respondents felt that there had been too much emphasis on nurseries and garden centres. It is observed that the general level of awareness by landowners (gardens and woodlands) is very low. Typically interest is triggered only once there has been an outbreak and there is a specific threat to their site.

One of the positive impacts of the *Pr/Pk* programme is that relationships have developed between Defra and external stakeholders and partners who are all now communicating better with each other. The programme has also contributed to a developing awareness that there are responsibilities beyond the government, and that solutions must involve more than just financial resources. It is important to continue creating a momentum with stakeholder and public organisations in developing the skills and knowledge that are needed to keep inoculum levels manageable. Permanent biosecurity practices need to be encouraged that will continue even in the absence of government intervention. Positive stakeholder engagement contributed to improved negotiations on the ground with the inspectors, and facilitated research permission for scientists in some gardens. Continuity in staff to maintain established working relationships is essential, not least because officials who have built up such relationships understand the landowners concerns and are able to reach adequate compromise.

There is a low level of public awareness of *Pr/Pk*. As previously acknowledged, in the context of gardens, there are difficulties about how to best engage with the general public over *Pr/Pk* risks. Thus the low level of public awareness can possibly be partly explained by the compromised nature that many of the stakeholders are in when they are considering commercial interests, and thus the low profile is deliberate.

There are disparate views on whether there should be a greater role for the public in managing future action on *Pr/Pk*. It is important to consider what the role for the public could and should be.

It was argued that the most of the general public would not have sufficient knowledge/interest, dedication or experience to be of assistance. Training would be prohibitively expensive. The concern that the public sending in sample of possible infections would lead to a huge workload has been articulated. However, others called for enhanced vigilance by the public and were supportive of more use of the public in disease surveillance, increasing the likelihood of early detection than could be managed officially. If involved in this way, the public might also be more supportive of management measures such as closing footpaths or land clearance at a future date. It was suggested that greater use could be made of the "informed" public (for example wildlife groups) for reporting suspect cases of plant diseases Again this would need careful management to avoid potential resource overload. The appointment of a dedicated official to separate the wheat from the chaff with regards actual sample testing, and to record the spatial distribution of reports in order to identify areas of concern would have the additional benefit of potentially flagging up the establishment of new disease threats. There was general agreement for a need for government to promote a greater understanding and foster awareness of general good biosecurity practice, ensuring that advice and guidance is followed to help limit the potential spread not only of *Pr/Pk*, but future biosecurity risks as well.

7. The International Context

The report also considers the international context in terms of the role of mainland Europe and the experience of managing SOD in the USA. From the outset the UK has led action on *Pr (*and *Pk)* and been strongly influential in determining the nature of the EU regime and having European-wide measures has been a major benefit. There has been autonomy in the UK to define its own management regime, with Article 16(2) emergency action to use within the UK. Whilst the UK and the USA have been active in tackling the threat from *Pr,* both in terms of research and practical management, it is argued that the controls are not applied equally rigorously across all Member States and that other member states did not see it as a problem on such a scale and were not as concerned about the consequences as the UK. This may be partly due to the difficulties of Member States managing their epidemics unilaterally, but is also due to the protection of commercial interests. However, the effects this had on the level of diseased plants reaching the UK were disputed. The extent to which infected material from the continent was continuing to enter the UK is something of a contention. For some, the EU continues to be a source of infected material into the UK, despite the effective UK controls. For others, however, this did not seem to be having any impact on the effectiveness of the UK controls

Collaborations with other Member States on research and information sharing for *Pr/Pk* are obviously essential. However, whilst has been some good collaboration with some European laboratories, sharing of type cultures and information, there are indications that the flow of information between mainland Europe and the UK has been somewhat asymmetrical, partly due

to the higher commitment of the UK authorities to research into *Pr* but also due to commercial interests.

Pr is responsible for the current outbreak of Sudden Oak Death (SOD), a major tree disease epidemic affecting large parts of California and Oregon in the USA. The different political contexts, temporal and spatial incidence of the disease, susceptibility of ecosystems and land ownership between California and Oregon contribute to two contrasting approaches and institutional structures for managing SOD in the two States. Whilst the species of plants and trees affected, the environments affected and the social and cultural impacts are different to the UK, there is much of the USA experience and management approach that is valuable to controlling *Pr/Pk* in the UK. Through the presentation of case study material, this report describes the measures taken in a number of different environments. Of particular interest is the 'Californian Oak Mortality Task Force' (COMTF): Whilst this model for stakeholder engagement is different from the UK and is based on an 'extension service' with outreach co-ordinators and public information officers, many aspects of it are very valuable for the UK. The COMTF website acts as a 'one-stop shop' central information hub for information on SOD. This approach would be valuable in the UK context, with resources specifically tailored to different stakeholder groups.

8. Wider plant biosecurity concerns

Many of the criticisms and suggestion made in this report have a wider relevance to generic plant biosecurity issues. It is critical that *Pr/Pk* is seen as a key experience from which lessons can be learnt, and strategies put in place, for the management of not just new pathogens that are 'spotted on the horizon', but critically, future yet 'unknown' plant health threats. Given weaknesses in international regulation, the potential for pathogen evolution and the impacts of climate change, it is key that at local and national levels, stakeholders and the public alike are encouraged and facilitated through the provision of information, and financial support where appropriate, to take on responsibility for biosecurity, and to manage their land in a way that increases their ability to deal with future threats.

9. Recommendations for future policy direction

This report concludes by making recommendations for future policy direction. These are made by the authors based on an objective analysis of a collation of the information provided by the respondents to this research, as discussed within the report.

First of all it is recommended that there is an increase in the number of staff tasked with pro-active surveying, monitoring and testing for new *Pr/Pk* outbreaks. The possibility for staff from other land-based organisations, who are already working in susceptible habitats, taking on these roles,

should be explored. It is also suggested that a new co-ordinating role (s) at national and/or regional levels would be useful in this context.

Secondly, it is recommended that garden management plans for infected gardens, and gardens considered at high risk from *Pr/Pk* in the future, are developed in a co-operative manner between garden owners and/or head gardeners, and the plant health authorities. These should ensure support for the gardens in the effective management of the disease, but also play a strategic role in setting out a plan for the future evolution of the garden. They should include a compulsory regime of rigorous hygiene practices within the garden and, where relevant, a management plan for the visiting public.

The third recommendation is that research to inform disease management in the gardens is carried out; specifically it would be useful if this included the relative level of susceptibility and resistance of different species and cultivars, and if there is a difference for *Pr* and *Pk* within the garden environment. Consideration of whether this is affected by local climatic conditions, as well as the relative levels of sporulation for different species and cultivars would also be useful.

Fourthly, it is recommended that clearance of *R. ponticum* continues to occur at infected sites, but that the Programme ensures that clearance occurs on all land-types where it is necessary, and that the pattern of clearance does not leave reservoirs of inoculum to build up. It is also recommended that there is pro-active clearance of *R. ponticum.* Given limited resources, this should be focused on sites which are particularly valuable for biodiversity, or in cultural terms, and in particular in areas where there is *R. ponticum* in conjunction with high levels of *Vaccinium*.

The fifth recommendation is that resources are focused on research into *Vaccinium myrtillus* infection, as outlined in Section 9.4 of the main report, as a matter of urgency. In this context, a national policy on protecting heathland ecosystems and disease management should be developed. The sixth recommendation is related, and states that the other research suggestions made by respondents to this research and as listed in Section 9.5 of the main report are given serious consideration and action taken when deemed necessary. The seventh recommendation is that the further funding is made available for the micro-propagation unit at Duchy College to continue its work, but that a clear plan of where the new, disease-free plant material will be placed in both the short, and long-term, be developed.

Recommendation eight suggests that an education programme focused on generic plant and tree biosecurity risks, and targeted at specific sections of the general public (e.g. garden visitors, ramblers, dog walkers) and at particular stakeholder groups (e.g. professional gardeners, landscape architects) be developed and implemented. Resources aimed both at individuals and

for delivery through existing civil society groups would be beneficial. This needs to be presented an accessible, fun and informative way. For example, the development of a 'Biosecurity Code' modelled on the existing 'Countryside Code' may be an effective way of engaging the general public. Recommendation nine advises that the suggestions for new stakeholders to be brought on board under the new Programme of work (as listed in Section 9.8 of the report) are given consideration, and action taken when deemed necessary.

The tenth recommendation is that consideration is given to how responsibility for *Pr/Pk* management between Fera (Defra) and PHSI can be more effectively distributed and co-ordinated, particularly in relation to scientific research and survey work. It is suggested that a single survey database is created. It is also suggested that the responsibilities of the different agencies are always clearly explained to stakeholders and the public to avoid confusion. Finally, it is recommended that the suggestions listed in Section 9.10 of the report on the future structure of the Programme Board be considered and changes made where deemed necessary.