Plant Health Centre
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Riaghaltas na h-Alba

Identifying key questions and leverage points for plant health in the natural environment

Project Final Report

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Forest Research

The James Hutton Institute

University of St Andrews

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Content

1 Executive summary

There is good evidence of the considerable risks to plant health from non-native plant pests in the natural environment (semi-natural habitats). In addition, stakeholders often lack awareness of these risks and may not always implement appropriate biosecurity measures. The challenge is how to implement actions that improve behaviours around plant biosecurity given the limited resources available and under-recognition of this issue within the natural environment and conservation sector. One mechanism that maximises the impact of effort is to identify leverage points; small changes within a system that can have a big effect on people's behaviours and attitudes with respect to biosecurity in the natural environment. Following a one day, in-person workshop this project identified mechanisms to strengthen project, organisational and system-wide actions and processes for improved biosecurity in the natural environment in Scotland.

In this report natural environment refers to all semi-natural habitats e.g. moorlands, mountain tops, grasslands, sand dunes, reedbeds, native woodlands and wetlands. We are not referring to solely pristine habitats or those habitats that are not modified by humans, but rather those habitats that are not in active management for agriculture, horticulture and commercial forestry.

Leverage points were identified at three levels: project, organisational and transformational (across projects/organisations/policies). There are two key actions required to implement these leverage points; 1) Where appropriate (as indicated below) actions to implement the leverage points should be included within the revised Scottish Plant Health strategy and/or the targets for the Scottish Biodiversity Strategy; 2) An implementation plan should be developed covering both the recommendations from this report and from previous PHC reports on leverage points (White, Watkins et al. 2023).

Plant pests do not stop at country boundaries. Identification of roles and responsibilities and leverage points to improve biosecurity in the natural environment need to happen across the devolved nations within the UK. These country-level discussions should be joined up across the UK, so there is a co-ordinated approach, for example through the Joint Nature Conservation Committee (JNCC).

Key leverage points identified at project, organisational and transformational (across projects/organisations/policies) levels are as follows, with implementation suggestions:

<u>Project level leverage points</u>

- The identification by Scottish Government of who is responsible for plant health in the natural environment. This could be considered as part of the revised Scottish Plant Health Strategy. (After the workshop and prior to the publication of this report the revised Plant Health Strategy was published which commits to ensuring "*that control responsibility for plant health in the Natural Environment is appropriately assigned to a relevant organisation*").
- The inclusion of a biosecurity requirement within grant schemes for habitat restoration and creation. This could be considered as part of the revised Scottish Plant Health Strategy.
- Improved training for contractors in biosecurity – particularly around the importance of clean machinery.
- The development of a programme to monitor plant health in the natural environment. This could be considered as part of the revised Scottish Plant Health Strategy.

- Change in perceptions of biosecurity from it being a barrier to meeting targets for habitat restoration to an action for inclusion for the successful delivery of habitat restoration.
- Provision of improved clarity over the trade-off between the costs and benefits of increased biosecurity, i.e. choosing not to move plants for biosecurity reasons versus moving plants for increased species or genetic diversity for resilience. This could be considered as part of the revised Scottish Plant Health Strategy.

Organisational leverage points

- The identification by Scottish Government of a responsible organisation for plant health in the natural environment, clarification of any overlaps in responsibility with other organisations (e.g. with NatureScot or Scottish Forestry), and provision of appropriate resourcing. This could be considered as part of the revised Scottish Plant Health Strategy. (Many workshop attendees assumed plant health in the natural environment was the responsibility of NatureScot, but this is not currently within their remit. After the workshop and prior to the publication of this report the revised Plant Health Strategy was published which commits to ensuring "*that control responsibility for plant health in the Natural Environment is appropriately assigned to a relevant organisation*").
- Improved plant health and biosecurity training within continuing professional development (CPD) in all organisations working in the natural environment. This action could be progressed by inclusion of such training within NatureScot's 'adapt policy'.
- The use of network or membership organisations' networks/newsletters/events to promote biosecurity.
- Where appropriate, inclusion of plant health and biosecurity in responses to consultations on new policies/regulations/grant schemes. This could be considered as part of the revised Scottish Plant Health Strategy.

Transformational (high-level) leverage points

- Awareness and consideration of biosecurity, as well as accountability, embedded into existing best practice guidance within the conservation and restoration sector. This action could be progressed through inclusion within the revised Scottish Plant Health Strategy and taking it into account when identifying responsible organisations for delivery of the Scottish Biodiversity Strategy.
- Biosecurity to be considered as part of wider discussions around sustainability and risks. This action could be progressed by organisations within the conservation sector including biosecurity in training, CPD, campaigns and inclusion of appropriate biosecurity as a requirement for access to grants.
- Clarification of the responsibility of NatureScot (or another organisation) for plant health in the natural environment, combined with sufficient resourcing to implement this responsibility and enable promotion of plant health in this sector. This could be implemented through the revised Scottish Plant Health Strategy.
- Increased policy coherence. This could be achieved through mainstreaming biosecurity in the natural environment through government departments as part of the revised Scottish Plant Health Strategy. An initial action could be to include biosecurity in the natural environment within discussions held by the Environment and Economic Leaders group and the Scottish National Adaptation plan.
- Through training there needs to be a greater understanding of the language of uncertainty which then translates to an understanding of when and how to implement the precautionary approach with respect to biosecurity, and the natural environment.
- Grant schemes designed to target both maintaining existing habitats/sites already in good condition and creating/restoring habitats which can be resilient, rather than a

focus on X ha of restoration. This action could be taken into consideration when developing targets for the Scottish Biodiversity Strategy.

- Grants and payments should look to move to payments for outcomes rather than outputs: this would have a wide range of biodiversity benefits including improved biosecurity.
- Development of a mechanism, with appropriate funding, to enable landowners to work together e.g. across a catchment, to deliver diverse, resilient landscapes. This action could be implemented via the land use strategy.

2 Introduction

2.1 Introduction to plant health and the natural environment

There is increased awareness of the impact that non-native plant pests and pathogens (referred to as 'pests' throughout this report) can have in agriculture, horticulture and forestry, but little awareness of the potential impacts in the natural environment. When considering plant pest impacts on the natural environment (see Box 1 for definitions) the focus is often still on trees rather than on non-tree plants. A previous Plant Health Centre report (Mitchell 2023) identified that there are a number of plant pests listed in the UK Plant Health Risk Register (Defra 2021) that could be hosted by plants in non-woodland habitats. These risks and impacts are rarely considered. For example, the impact if heather (*Calluna vulgaris*) were to decline due to infection by *Xylella* or a *Phytophthora* species could be substantial: A range of biodiversity would likely be impacted, for example, grouse, hen harriers, capercaillie and merlin. The loss of heather could result in our moors becoming more grass dominated, depending on what species move in to fill the gap. If the decline in heather was rapid, there is the potential this would drive soil erosion, carbon loss and decrease water quality with resulting cultural, economic and visual impacts (Mitchell 2024).

When considering the potential impacts of plant pests on the natural environment both the risks with respect to the pests arriving and establishing, as well as the risks caused by the actions or inactions of stakeholders working in the natural environment need to be considered. Mitchell (2023) highlighted that stakeholders involved in habitat restoration or creation often:

- had inaccurate perceptions of risks with respect to plant health,
- did not have a risk assessment for biosecurity,
- did not check that any biosecurity protocols were followed,
- did not have anyone responsible for biosecurity,
- did not monitor plant health after completion of habitat creation/restoration.

Biosecurity refers to measures aimed at preventing the introduction or spread of harmful pests (see definition below) intentionally or unintentionally outside their native range or within new environments.

Pests and pathogens include bacteria, fungi, insects, mites, nematodes, oomycetes, phytoplasma, viruses and viroids, and are collectively referred to throughout as pests. While pests are a natural part of ecosystems we concentrate here on non-native pests that might accidently be introduced.

Plant health is defined as the plant health consequences of biotic agents i.e. pests and pathogens. We are not referring to the impact of poor management, vertebrate herbivores, poor soils or the direct impact of changes in climate on plants (although climate change will impact pests/pathogens severity/distribution).

The natural environment refers to all semi-natural habitats e.g. moorlands, mountain tops, grasslands, sand dunes, reedbeds, native woodlands, wetlands. We are not referring to pristine habitats or those habitats that are not modified by humans, but rather those habitats that are not in active management for agriculture, horticulture and commercial forestry such as heathlands, moorlands, grasslands, wetlands and native woodlands.

Box 1 – Definitions of biosecurity, pests, plant health and the natural environment as used in this report.

The Mitchell (2023) report concluded that there was good evidence of considerable risks to plant health in **all** semi-natural habitats and that although the likelihood of some of the pests establishing might be low, the ecological impact could be high. Good biosecurity within the natural environment is key to reducing the risks and supporting its future health, diversity and resilience.

Mitchell (2023) listed 7 actions that would improve plant health in the natural environment (Box 2). Action is urgently needed, as habitat restoration and creation is key to many policies, such as the Scottish Biodiversity Strategy. Without an increased awareness of the risks and measures to reduce them, and subsequent altered biosecurity behaviours, policies that are intended to benefit biodiversity could have unintended consequences, in terms of accidental introduction of plant pests.

What we need:

- Greater awareness of the plant health risks to **ALL** habitats
- Plant biosecurity included in all habitat creation and restoration work
- Increased stakeholder awareness
- Better risk assessments and biosecurity protocols
- Responsibilities for plant health and biosecurity clearly identified
- Monitoring – baseline (what does plant health look like now) and after restoration.
- A reporting/identification processes for pests in natural habitats outside of woodlands

Box 2 – Key conclusions of actions needed to promote plant health in the natural environment as identified by Mitchell (2023).

The challenge is how we implement these recommendations given the limited resources available for conservation/nature/habitat restoration and creation. One mechanism that maximises returns on effort invested is the identification of leverage points within the projects and organisations operating in the natural environment.

The overall aim of the project was to **identify how we can strengthen project, organisational and system-wide actions and processes for improved plant health and biosecurity behaviours in the natural environment in Scotland**.

2.2 Introduction to systems thinking and leverage points

Systems thinking is a way of framing the complex interactions between people, organisations, processes and policies. It recognises nodes, interactions and feedback loops. Leverage points are places within these complex systems where intervention can cause transformative change. As shown by a previous Plant Health Centre report, system thinking and leverage points offer new ways to consider threats and management of plant pests and pathogens (White, Watkins et al. 2023). In particular, the use of a system approach offers the opportunity to identify small actions or leverage points that can have a big effect on a system (Figure 1), in this case, people's knowledge, values and behaviours with respect to biosecurity in the natural environment.

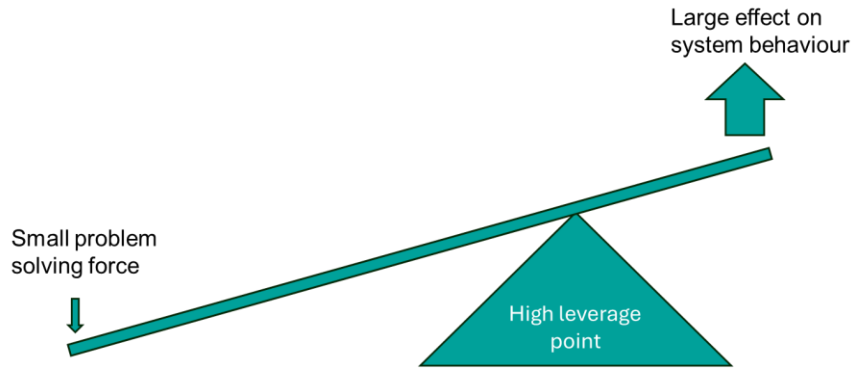

Figure 1 – Diagram of leverage points – a small force can have a big impact on the system.

Leverage points can have different magnitudes of influence (Fig 2). In systems thinking, leverage points vary in form and influence - from shallow to deep. Meadows (1999) suggested a 12-point scale of influence, but these have more recently been reduced to four different types (Abson et al 2017). With increasing amounts of influence and thus potential for system transformation, these are: parameters, feedbacks, design and intent. Abson et al (2017) explain that parameters are mechanistic characteristics such as subsidies, taxes and standards, which are the leverage points typically targeted by policy makers. Feedbacks are the interactions between elements within a system of interest that drive internal dynamics, and include things such as the strength of negative feedback loops and the gain around driving positive feedback loops, such as response to an incentivisation scheme. Parameter and feedback leverage points are often used when trying to change a system, as they are easier to implement than design and intent leverage points, but they typically have a smaller (shallower) impact on the system. Design leverage points include changes to the social structures and institutions that manage feedbacks and parameters, such as the flow of information, the rules of the system and the power to change the system structure. Intent leverage points re-orient the system by changing worldviews or paradigms, such as the underpinning values and goals of actors. Leverage points classified as Design or Intent have greater (deeper) potential to implement larger changes within the system but are harder to implement as they involve changing social structures and institutions or transforming world views or paradigm of actors. This project aimed to look at leverage points along this spectrum (Figure 2).

Leverage points and system thinking have previously been used when examining how to enhance biosecurity in garden design and landscape architects/construction (White, Watkins et al. 2023). The present project aimed to build on this recent work and utilise the leverage points and systems thinking approach in the more complicated system of the natural environment, where there is a high diversity of stakeholders with more diffuse apparent responsibility.

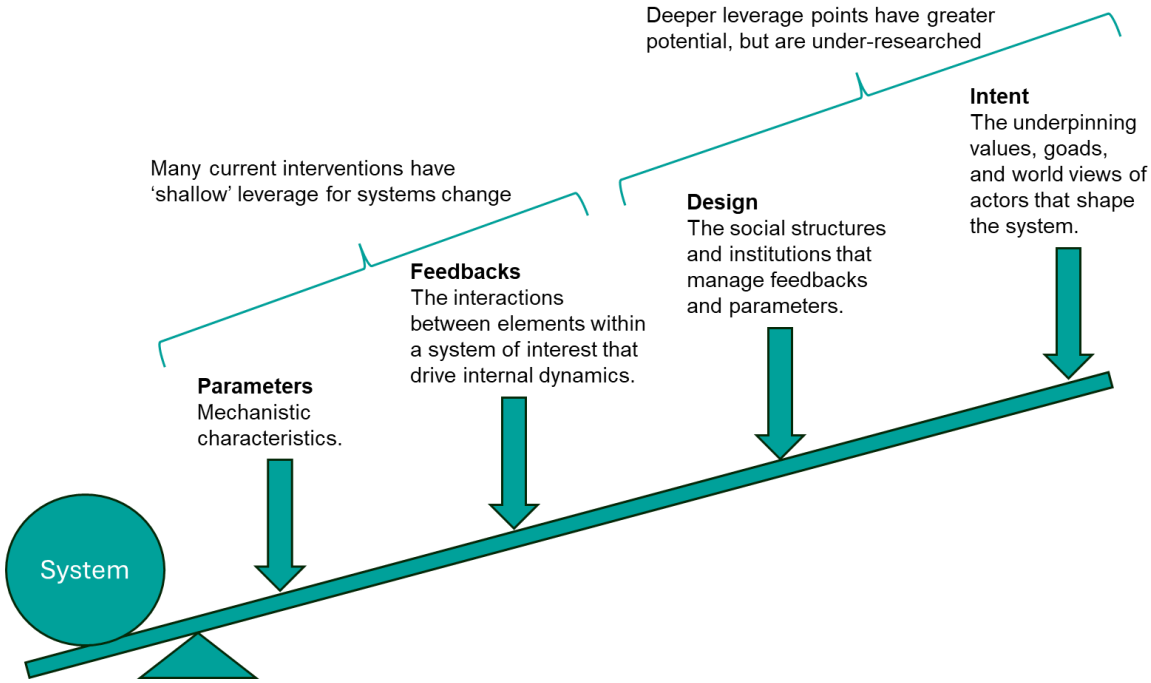

Figure 2 – Different types of leverage points within a system. Adapted from Meadows 1999, Abson et al 2017, and Fischer and Riechers 2019

3 Methods

3.1 Defining the focus of the study

An online expert panel was held at the start of the project. Five key informants with senior roles in government agencies and conservation non-governmental organisations (NGOs) met with research team members. The meeting introduced the project, plant pest threats to the natural environment and the potential of systems thinking. Participants explored how a system diagram could be applied to the natural environment, investigated potential case studies and discussed potential stakeholders. A Padlet collated insights to take forward in the project. It was agreed to focus the project on hedgerow planting, riparian planting and peatland restoration, as these case studies were active and ongoing and included a range of issues and stakeholders.

In discussion at this online expert panel meeting, it was acknowledged that the natural environment covered a wide range of stakeholders and habitats. Stakeholders include, but are not limited to, those working/managing semi-natural habitats and those who use these habitats for recreation. This project focuses on those directly involved in biodiversity conservation. It was agreed that this project would focus on a few case studies based on key habitats/organisations/activities from within the biodiversity conservation sector, although we recognise the need for further work on other sectors, particularly in relation to large scale civil engineering projects and recreation.

The main activity for this project was a one day, in-person, workshop held at the University of St Andrews in August 2024. Ethical permission for the workshop was granted by the University Teaching and Research Ethics Committee at the University of St Andrews. After an introduction to the importance of plant health in the wider environment and systems thinking, participants worked in breakout groups across three systems diagrams that covered different levels of leverage: projects, organisational and transformational change (Figure 3). Systems diagrams and descriptions were developed for each level, to facilitate discussion. Participants from the following organisations attended: Royal Botanic Garden Edinburgh, Scottish Rewilding Alliance, National Farmers Union Scotland, NatureScot, JNCC, Defra, SASA, and Royal Society for the Protection of Birds (RSPB). Other organisations were invited but representatives were unable to attend.

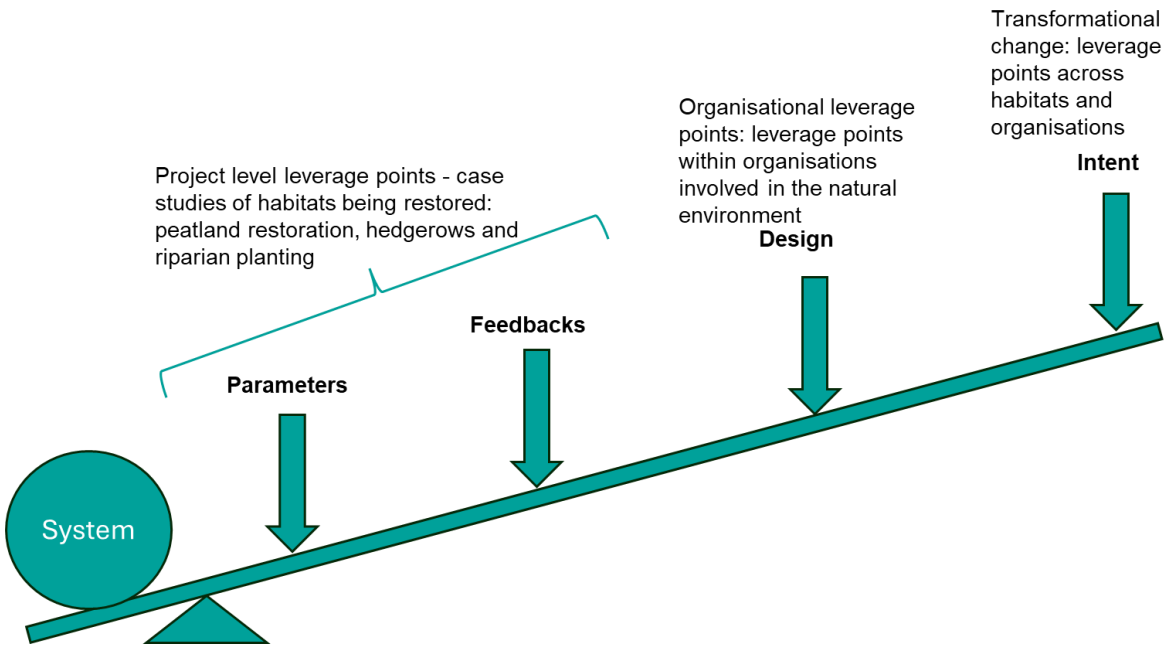

Figure 3 – The three types of leverage points assessed during the workshop: project, organisational and transformational.

3.2 Project level leverage points

Peatland restoration, creation of hedgerows and riparian planting were the three case studies used to identify leverage points within projects that spanned a wide range of different organisations. For the first activity, participants were introduced to a generic systems diagram (Figure 4) and were asked to identify specific activities that would improve biosecurity within each case study. Participants self-selected two case studies, sequentially, and worked in groups with research team facilitators to add comments to the systems diagram, highlighting areas of interest for biosecurity. This diagram broadly outlined actions taken before work on the ground, including development of application and funding process, and then actions taken during the activity and in subsequent maintenance, including plant sourcing, contracting and machinery.

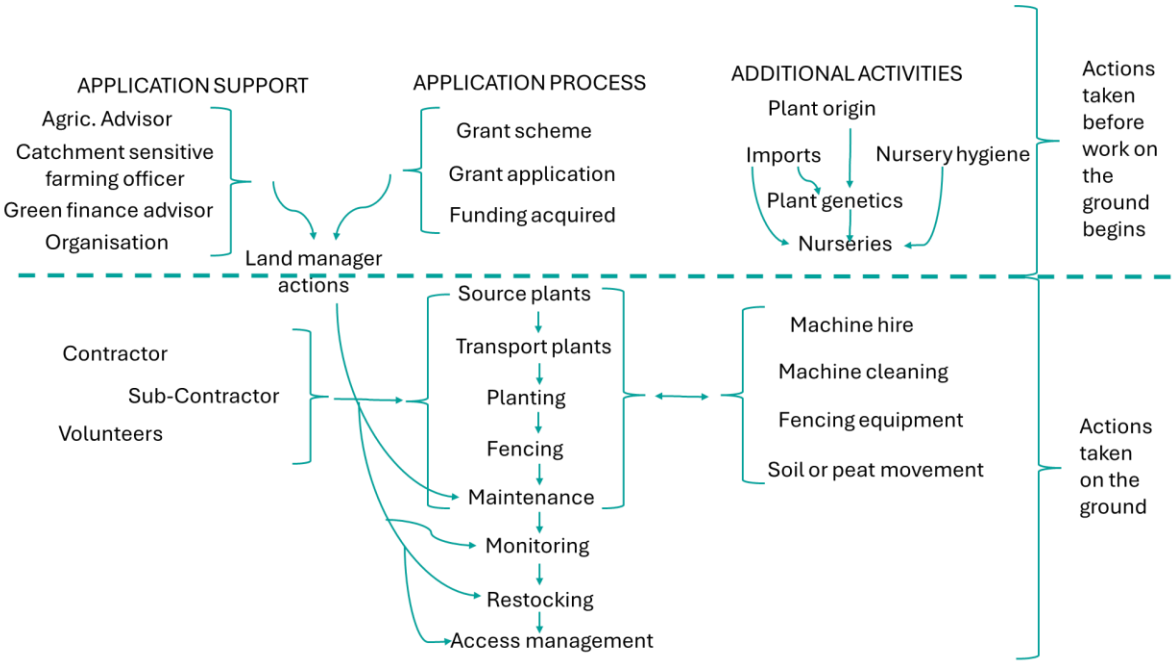

Figure 4 – Generic project level systems diagram for identification of parameter and feedback leverage points presented to workshop participants

3.3 Organisational level leverage points

The workshop participants were asked to brainstorm the organisations that were involved in the natural environment and that might have a role in promoting biosecurity. From the extensive list generated, including government agencies, a range of NGOs and some organisations representing landowners or managers, three organisations: NatureScot, Horticultural Trade association and Scottish Rewilding Alliance were chosen to focus on in more detail. Participants were asked to identify leverage points within and outside each organisation that could be influenced to improve biosecurity within that organisation and from the actions of that organisation. Once again, participants were given a generic systems diagram (Figure 5) and were asked to notate specific activities for one of the three organisations, with participants self-electing and a team member facilitating the groups. Potential leverage points included external processes such as regulations and client choices and internal organisational processes such as training, communication or practices undertaken.

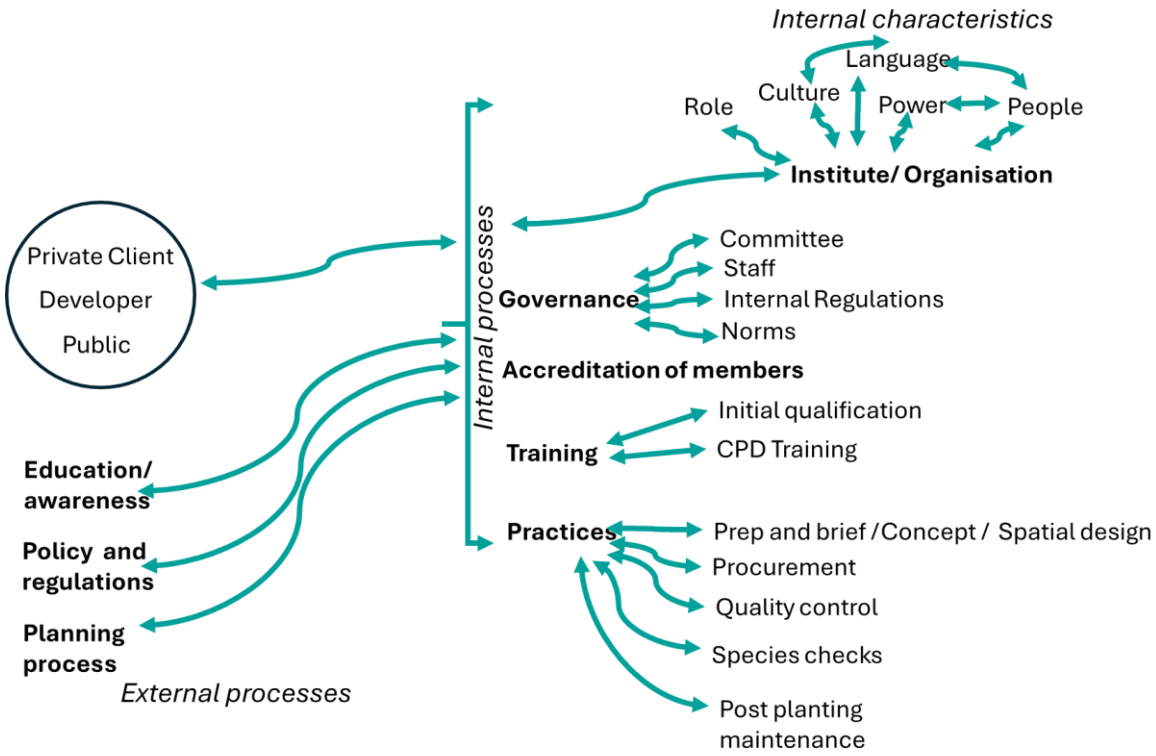

Figure 5 – Generic organisational level systems diagram for identification of design leverage points presented to workshop participants

3.4 Transformational level leverage points

Identification of transformational leverage points transcends project and organisational level thinking. Participants were asked to think across organisations, policies and government departments to identify high level activities that could improve biosecurity. To initiate discussions, they were given the framework developed by Mitchell (2023) that helped to prioritise plants and habitats to monitor for plant health and five activities that would promote plant health in the natural environment (Figure 6). Participants were also shown Figure 7, which was adapted from a framework developed by Pollard et al (2022) for a previous Plant Health Centre project exploring system and scale issues and perceptions of risk, cost/benefit and uncertainty in influencing stakeholder decision making and action for precautionary planning.

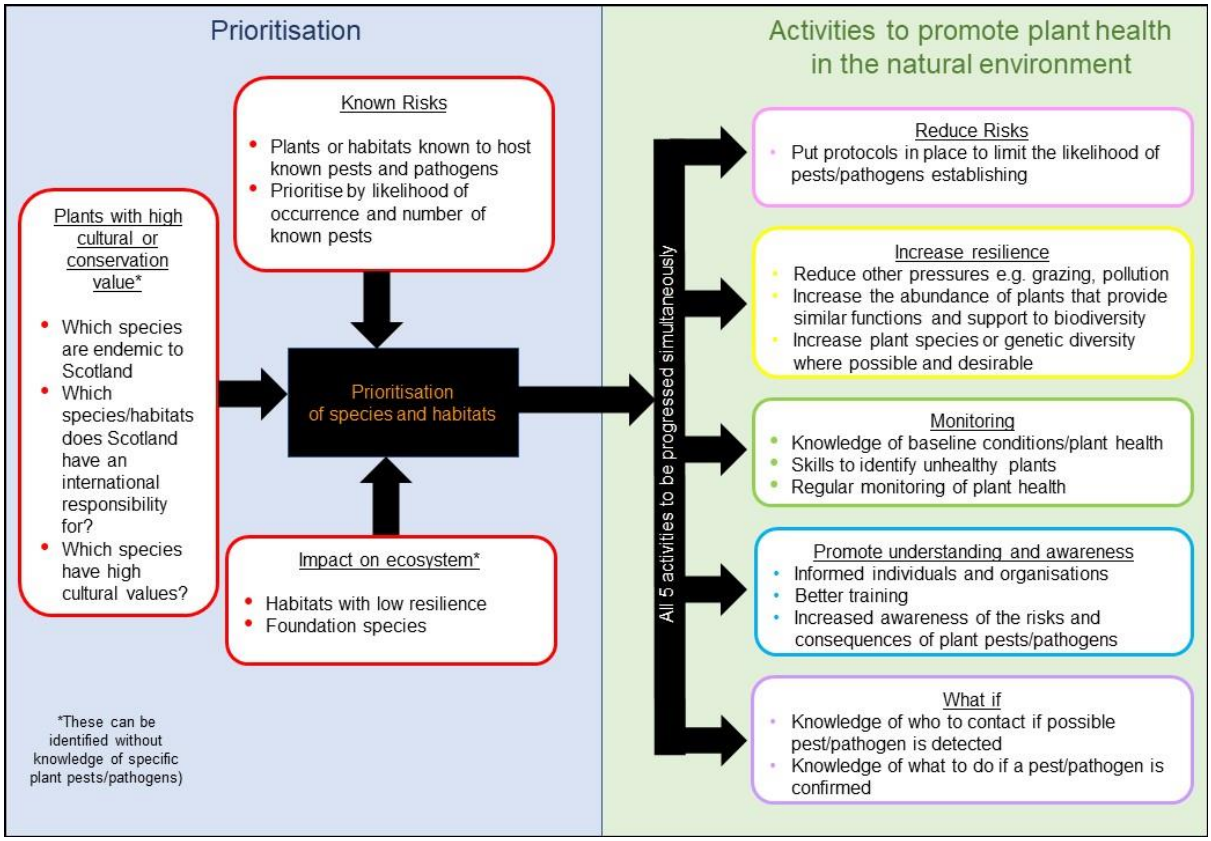

Figure 6 – Framework for improving plant health in the natural environment from Mitchell (2023) used to identify transformational change (intent leverage points) by workshop participants

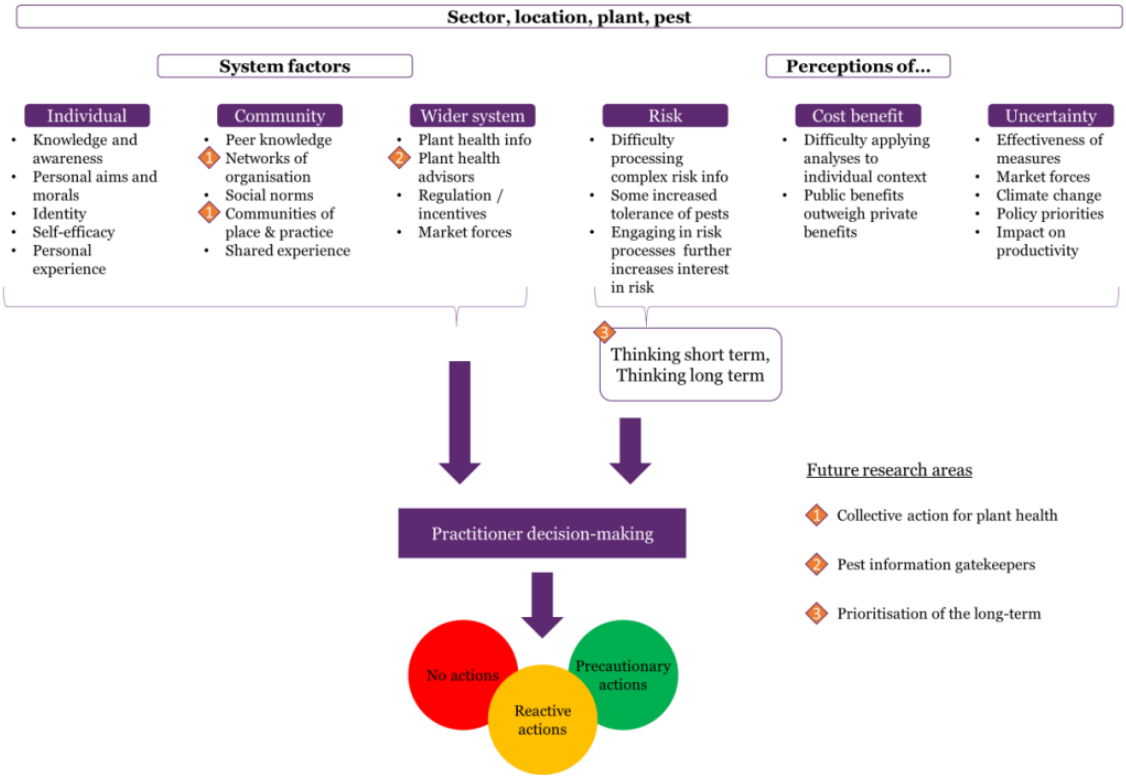

Figure 7 – Framework adapted from Pollard et al (2022) from a previous Plant Health Centre project presented to workshop participants

4 Results

Throughout the workshop we tried to make the identification of leverage points as specific as possible. At times, key individuals were identified, but no individuals have been named in this report for reasons of confidentiality.

4.1 Project leverage points

Across the three case studies of hedgerows, riparian planting and peatland restoration some common leverage points were identified (Figure 8).

All case studies identified that the inclusion of biosecurity within the grant scheme or application process was an important first step, which could be included as a recommendation in the revised Scottish Plant Health Strategy. This would ensure that biosecurity becomes a key consideration from the start of a project. Grants were also viewed as important in shaping the maintenance and monitoring of the project, with monitoring in particular identified as another key leverage point. In particular, a number of environmental organisations provide grant schemes which do not currently include biosecurity as part of their grant awarding conditions. However, the peatland breakout group commented that it can be difficult to make changes to current grant application processes. Rigid legislation makes it hard to alter existing application processes to include biosecurity. A solution is for legislation to ask for restoration to be undertaken in accordance with details in an Annex and then the Annex could be updated without need to change the legislation. Both the hedgerow and the peatland group noted that stressed systems due to a changing climate (for example peatlands drying out on the east of Scotland) are more likely to be infected with pests. Grant application processes could be targeted towards sites where the habitats are predicted to be less stressed and hence less likely to become infected with pests.

For restoration work that involves introducing plants (case studies on hedgerows and riparian planting) nurseries were identified as a key place where biosecurity could be improved, particularly small, specialist nurseries, which are often harder to reach with biosecurity messaging.

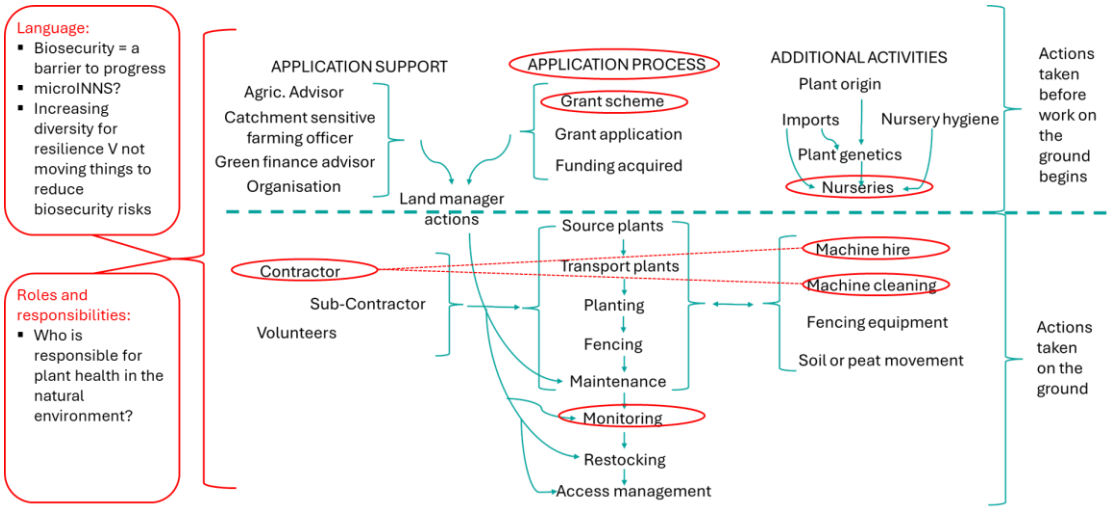

Figure 8 – Summary of common project level leverage points across three case studies: hedgerows, riparian planting and peatland restoration. Key leverage points highlighted in red with additional points from outside the system added in red boxes.

Contractors were also seen as a key leverage point across all case studies but particularly in peatlands, where they were linked to the movement of specialist machines across northern England, Wales and Scotland for peatland restoration, with the potential risk for accidental movement of plant pests if the machinery is not properly cleaned. Within peatland restoration the landowner has the legal contract with the contractor, however the NatureScot representatives at the workshop felt that Peatland Action (NatureScot) has the best contacts and relationships with the contractors and would be best place to provide training to the contractors about biosecurity. The group felt it was often unknown whose responsibility it was to make sure machines were cleaned prior to movement between sites and the practical difficulties of cleaning machines where there was often not an easily accessible source of water to do so, were highlighted. Cleaning kits for machinery in remote areas would be a useful development.

Monitoring plant health was seen as key in all case studies if the restoration/habitat creation was to be successful, but there was uncertainty about what to monitor and who should be doing it. There was felt to be a lack of skills, with most advisors or managers unable to identify unhealthy plants and a general lack of understanding as to what "healthy" looks like for many plants. Development and improving monitoring of plant health in the natural environment. could be part of the revised Scottish Plant Health Strategy.

Outside of the project systems diagram, two broader issues were raised around language and roles and responsibilities.

In terms of language, inclusion of biosecurity measures within projects could potentially be viewed as a barrier to restoration, or something that would slow down the rate of restoration or take up a proportion of already limited funding available. Many habitats have targets of X ha restored each year and it was suggested by participants that any additional paperwork could be viewed by practitioners as a hindrance to achieving targets. Better engagement (awareness raising, knowledge and resources) is needed to highlight the risks and impacts of pests that could potentially destroy restoration efforts. The contrast of stakeholder's engagement with the prevention and removal of invasive non-native species (INNIS) e.g. mink, grey squirrel was made. There has been far greater uptake about prevention of INNS and their removal than around plant pests. It was suggested that an evaluation of 'lessons learnt' from the work around INNS could then be applied to pests. In some situations, the use of the term microINNS rather than pests might be more appropriate although while some workshop participants liked this terminology, others did not. Finally, participants identified potential conflict with the current messaging to diversify planting to increase resilience. Diversification for resilience potentially means moving plants around from one area to another to increase either species or genetic diversity, but biosecurity often highlights the need to reduce the movement of plants, to reduce the risk of accidently introducing a pest. These contradictory practices need to be unpacked in different contexts. The revised Scottish Plant Health Strategy might provide some initial guidance.

Who has responsibility for plant health in the natural environment is unclear and this was the second key message that emerged as an overarching issue from across the case studies. While many participants assumed this was NatureScot, NatureScot does not legally have this responsibility, making it hard for them to justify spending resources in this area. This issue was raised again in the organisational leverage discussion (see Section 4.3).

4.1.1 Specific Hedgerow leverage points

Leverage points specific to hedgerows identified were:

- Inclusion within grant specification that planting stock must be of high quality and grown in a biosecure environment, together with details of what species to plant as

well as origin/source to ensure that plants grow well locally and to avoid buyers always choosing the cheapest.
- Clear linkages between conservation objectives and biosecurity requirements.
- Grants need to be longer term to justify investment in good biosecurity.
- Monitoring should be long-term and include biosecurity gains and hedgerow health.
- Include biosecurity within reform of agri-environment schemes post Common Agricultural Policy (CAP) reforms (slow process), something such as Agri-environment climate scheme (AECs).
- Increased knowledge sharing between hedgerow planters: planters and maintenance workers tend to be local, meaning biosecurity risks are low, but knowledge sharing from other regions is limited (e.g. hedge maintenance is not traditional in Scotland but is increasing in popularity).

4.1.2 Specific Riparian planting leverage points

Two key points were raised that are not leverage points, but which are worth noting:

i. Riparian planting is high risk as planting next to a river means potential greater movement of pests.
ii. There is a need to better understand the balance between biosecurity risk versus biodiversity benefits of small-scale conservation activities that may have limited knowledge of biosecurity but be good for public engagement and potentially low biosecurity risk.

Leverage points specific to riparian planting identified were:

- Need to incentivise long term planning through grant schemes.
- Allow grant schemes to include natural regeneration – this would remove the need for extensive planting and associated risks.
- Focus grants on outcomes and not just based on number of trees/ha planted.
- Need to resource equipment to enable people to implement the 'Arrive clean, leave clean' principle for recreation, (fishing gear, kayaks, canoes, bikes). Biosecurity kits are rarely present at recreation sites.

4.1.3 Specific Peatland restoration leverage points

Leverage points specific to peatlands identified were:

- Need to get biosecurity principles into Peatland Action code.
- Training/CPD for Peatland Action staff should include biosecurity and skills to identify plant pests.
- NatureScot will launch NatureScot Adapts on 23/9/24 which looks at how to adapt to climate change and risks and could also include plant pest risks. The scheme will include in-house training, so could include biosecurity awareness training within it.
- Discussions between Peatland Action and contractors regarding the consequences of and opportunities for machine cleaning and biosecurity.
- Approach the Chartered Institute of Ecology and Environmental Management (CIEEM(to include biosecurity in their restoration handbook.

4.2 Identification of organisations working in the natural environment who should have awareness of plant health

The workshop sought to identify the organisations that were involved in the natural environment and whose remit therefore should include biosecurity and plant health. In total over 50 organisations were identified (Figure 9), and this was acknowledged to be an incomplete list. Broadly there were two types of organisations: a) those larger organisations where specific actions could be targeted within the organisation to promote plant health and b) membership or network organisations where their most effective role in promoting biosecurity would be through communication through their networks. It was beyond the scope of this workshop to identify leverage points within all these organisations, so three organisations (NatureScot, Horticultural Trade Association (HTA), and the Scottish Rewilding Alliance) were chosen to work on in detail (Section 4.3). Representatives from NatureScot, and the Scottish Rewilding Alliance were present at the workshop and fed into the relevant break out group.

Figure 9 – Selection of organisations that are involved in the natural environment in Scotland and who could influence plant health in the wider environment.

4.3 Organisational leverage points

The lack of clarity over which organisations are responsible for plant health in the natural environment was the key overarching message from the organisational leverage points analysis (Figure 10). While many assumed NatureScot have overall responsibility this is not currently within their remit, making it hard for this area of work to gain traction within the organisation due to resource constraints. The decision to assign a lead agency for plant health in the natural environment is fundamentally a matter for the Scottish Government. After the workshop and prior to the publication of this report the revised Plant Health Strategy was published which commits to ensuring "*that control responsibility for plant health in the Natural Environment is appropriately assigned to a relevant organisation*". Related to this, there also need to be clear lines of responsibility and communication between organisations where their responsibility for plant health in the natural environment might overlap. For example, there needs to be greater clarity over who has responsibility for plant health in native woodlands (NatureScot or Scottish Forestry). An absence of clear responsibility for plant health can lead to people feeling they lack power to implement or promote plant health within their organisation. In addition, the uncertainty over responsibility meant that many organisations have few, if any staff with a focus on plant health.

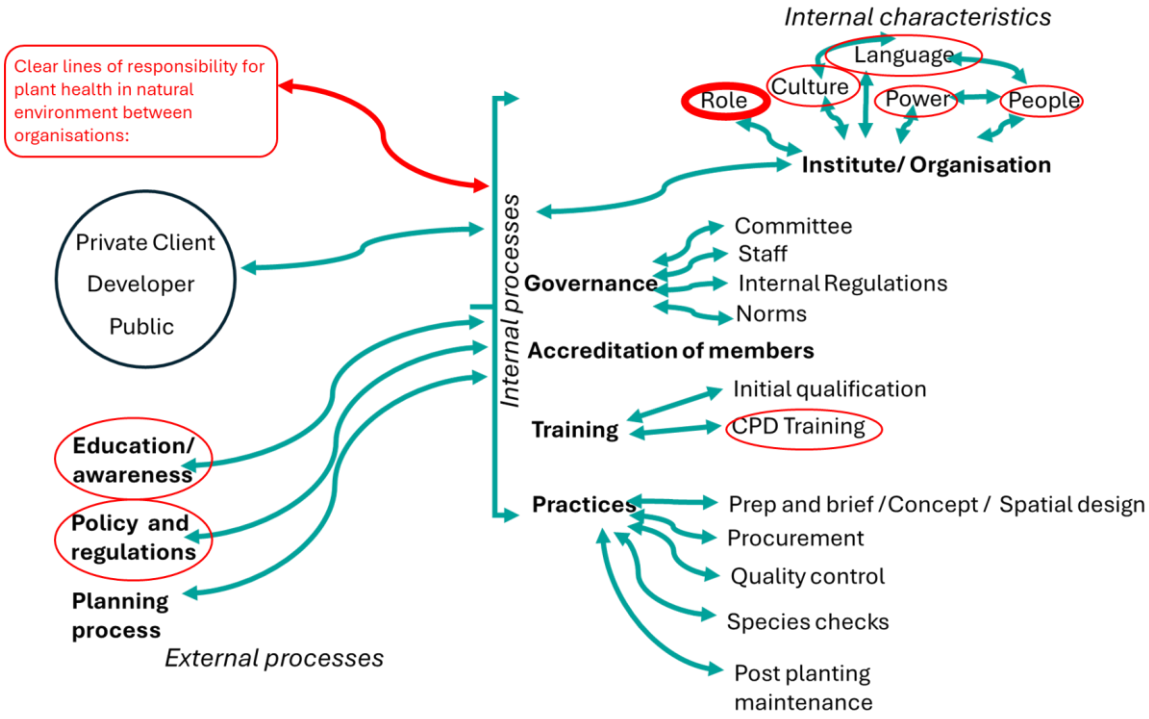

Figure 10 – Summary of common organisational level leverage points. Key leverage points highlighted in red with additional points added in red boxes. Role, circled in bold red was identified as the most important.

Similar to the project level, several participants identified language as important at the organisational level, with biosecurity and pests often perceived as being a separate issue from ecosystem health or resilience. It was considered that pests and biosecurity should be part of the conversation around resilience, risks and ecosystem health. For example, there are discussions within NatureScot to include plant health within assessments of the condition of protected areas.

Biosecurity needs to become part of the normal culture within organisations, not an optional extra, and this should be highlighted within the revised Scottish Plant Health Strategy. For example, when responding to consultations on policies and regulations or new grant schemes,

it should become the norm to reflect on whether plant health and biosecurity should be included.

Training, education and awareness were raised as potential leverage points in all the organisations discussed. However, the requirements of delivery need to be specific to the organisation. For example, NatureScot is about to launch its NatureScot Adapts policy (looking at all NatureScot activities through the lens of risk) and this will include CPD training which could include biosecurity. In contrast, discussion around organisations such as the Scottish Rewilding Alliance, which is a network organisation, favoured opportunities to promote biosecurity through speaking at their annual meeting, information in their monthly briefing email and potentially a training day on biosecurity. They highlighted that the expertise of the practitioners within the Alliance needs to be recognised and drawn upon and that it would be good to generate an open discussion on this topic. Similarly, HTA, as a membership organisation was viewed as an appropriate organisation to facilitate dissemination of information, but possibly less appropriate for pushing for change within organisations. For example, while the HTA was instrumental in the creation of Plant Healthy, they do not have the remit or capacity to run such schemes. Additionally, efforts to maintain and deepen engagement with stakeholders need to take a variety of forms to maintain efficacy.

4.4 Transformational change leverage points

Key leverage points for transformational change identified across discussion groups were:

- *Embed awareness and consideration of biosecurity, as well as accountability, into existing best practice guidance within the conservation and restoration sector*. This should be part of the revised Scottish Plant Health Strategy and be taken into account when identifying organisations responsible for delivering components of the Scottish Biodiversity Strategy. It could be achieved through working with the conservation sector to ensure biosecurity is considered as part of sustainability and risk assessment, which may involve changes to training, continuing professional development, campaigns and building into grant requirements. This should result in biosecurity being considered standard practice because of the resulting synergies, along with prevention of potential catastrophic consequences of accidental introduction of plant pests.
- *Clarity of responsibility for plant health in the natural environment and provision of resources*: the first step would be to clearly articulate which agencies have responsibility. This should be a key objective within the revised Scottish Plant Health Strategy.
- *Policy coherence*: biosecurity in the natural environment needs to be mainstreamed through government departments e.g. linking across environment, forestry, agricultural, this should be a key objective within the revised Scottish Plant Health Strategy. For example, biosecurity should be included in policies related to carbon and biodiversity credits plus any introduction of Biodiversity Net Gain or a Scottish equivalent. A first step to achieving a joined-up approach to biosecurity in the natural environment across government departments would be working with Environment and Economic Leaders Group which look at shared outcomes and brings together the CEOs of all the agencies. In addition, links should be made to the Scottish National Adaptation plan as a further measure to integrate biosecurity into wider government policies.
- *Greater understanding of the language of uncertainty:* scientists tend to talk about probability or likelihood which can be misconstrued by non-science audiences, managers and policy makers who desire certainty for decision making. There needs to be a greater understanding of probabilities and impact, which then translates to an understanding of when and how to implement the precautionary approach with respect to biosecurity, plant health and the natural environment.

- *A shift in funding for habitat maintenance and restoration/creation*: grant schemes should be designed to target both maintaining existing habitats/sites already in good condition and creating/restoring habitats which can be resilient rather than a focus on X ha of restoration. This should include a shift to paying for outcomes, which would have a wide range of biodiversity benefits including improved biosecurity. This should be taken into consideration when developing targets for the Scottish Biodiversity Strategy.
- *Facilitate (fund) landscape resilience for multiple landowners*: develop a mechanism to enable landowners to work together e.g. across a catchment to deliver diverse, resilient landscapes. There is nothing in current agri-enviroment schemes to facilitate this. There is a need to enable landowners to identify the strengths of collective action e.g. marketing as local produce. The land use strategy, due for consultation in 2024 and publication in 2026, might be an appropriate mechanism for this.

5 Conclusion and next steps

This work has identified a range of leverage points which could improve biosecurity in the natural environment. The recommendation of this project is to action implementation of these leverage points and to identify responsibilities and resources. The first key 'next step' identified is a need for written clarification by the Scottish Government of the responsibility of NatureScot (or an alternative agency) for plant health in the natural environment coupled with sufficient resourcing of NatureScot (or the alternative agency) to implement this responsibility. This would then provide a catalyst for the promotion of plant health and biosecurity across the wide range of organisations working within the natural environment.

The second key 'next step' is to develop an implementation plan to implement both the recommendations from this report and from previous PHC reports on leverage points (White, Watkins et al. 2023).

This project has highlighted the huge number and diversity of organisations working in the natural environment, where leverage points specific to each could be identified to promote biosecurity. It will be key to work with all organisations to improve biosecurity e.g. through basic training. In addition, membership organisations have huge potential to disseminate positive messages and discussion to empower members. Some very specific leverage points were identified within this report, often with named organisations. It is crucial that these leverage points are now implemented, through the implementation plan.

There is potential to transform the paradigm of biosecurity in the natural environment by engaging with debates on risk, adaptation, resilience, sustainability, diversity and climate change. Biosecurity can be introduced in a positive way to enhance practices overall, for example embedding biosecurity within standard best practise.

This project has shown the value of systems thinking at the project, organisational and system-wide level to identify a range of leverage points. Plant pests do not stop at country boundaries. Similar discussions identifying roles and responsibilities and leverage points to improve biosecurity in the natural environment need to happen across the devolved nations within the UK. These country level discussions should be joined up across the UK, so there is a co-ordinated approach through, for example, JNCC.

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