Darwin Plus Main: Annual Report

To be completed with reference to the "Project Reporting Information Note"
(https://darwinplus.org.uk/resources/information-notes)

It is expected that this report will be a **maximum of 20 pages** in length, excluding annexes)

Submission Deadline: 30th April 2024

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Darwin Plus Project Information

Project reference	DPLUS157
Project title	Managing the pathogens threatening St Helena's biodiversity and food security
Territory(ies)	St Helena
Lead Partner	CABI
Project partner(s)	St Helena Research Institute (SHRI), Environment, Natural Resources and Planning Directorate (ENRP)
Darwin Plus grant value	£ 265,440
Start/end dates of project	16/09/2021- 31/03/2025
Reporting period (e.g. Apr 2023-Mar 2024) and number (e.g. Annual Report 1, 2)	April 2023 – March 2024; Annual report 3
Project Leader name	Rob [redacted]
Project website/blog/social media	https://blog.cabi.org/2021/09/27/cabi-to-work-in-partnership-to-help-protect-st-helenas-biodiversity-and-enhance-its-agriculture/
Report author(s) and date	Rob [redacted], Norbert [redacted], Phil [redacted], Jayne [redacted] with contributions from SHRI and ENRP; 30 April 2024

1. Project summary

St Helena's endemic trees, insects and agricultural crops are currently threatened by unidentified pathogens. It is not known at this stage if the pathogens have been introduced to St Helena or are endemic pathogens becoming more virulent due to climate change. This project aims to survey and identify pathogens associated with the decline and death of the endemic tree species (including nursery stock), declining crop yields and the decline of endemic insect populations. Methods developed through CABI's Plantwise initiative will be used to build capacity in plant health diagnostics and management across all sectors, supporting growers, conservationists, and foresters. Identification of pathogens threatening insect and keystone cloud forest species is the first step to understanding and reversing the decline of the endemic ecosystem, reducing the threat of extinction of St Helena's unique flora and fauna.

Identification of pathogens impacting agricultural crops will generate a better understanding of any threats to food security and facilitate the development of management practices that will help to improve self-sufficiency and reduce the need to import food, preserve biodiversity and improve resilience to climate change. An important aspect of the project is to build island capacity in disease identification and management through training and improvements to laboratory facilities. The

development of management strategies and training can only be provided after initial surveys reveal the extent of the problems and which pathogens are causing disease.

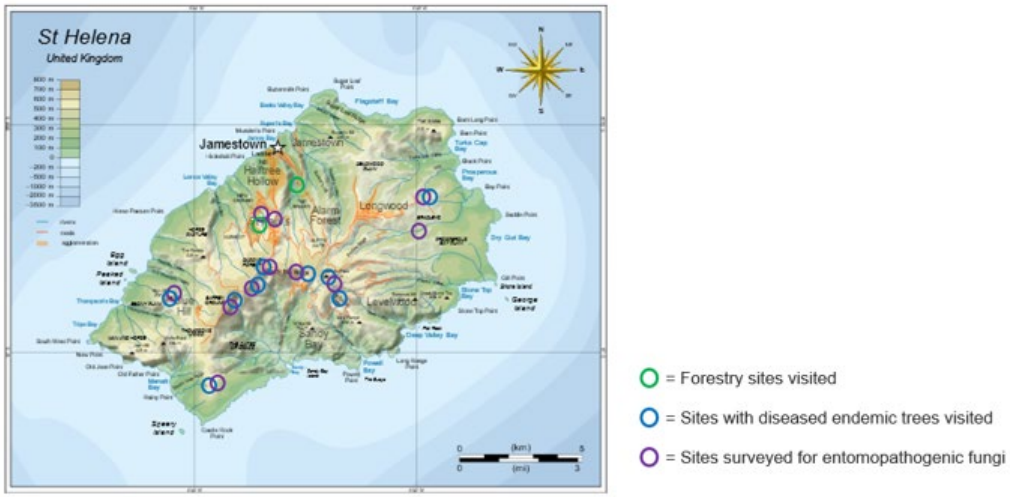

Figure 1: Map of St Helena showing the field sites visited by the project team between April 2023 and March 2024. For additional sites visited during the project see previous annual reports.

2. Project stakeholders/partners

The main project partners are CABI, ENRP, SHRI and BiFoR. The overall administrative management of the project is through Norbert Maczey (CABI) and coordination of the teams on St Helena by Rebecca Cairns-Wicks (SHRI). The main method of communication is through regular e-mail exchanges and videoconferences for the Project Management (Steering Group) which are held on a needs basis (12 meetings undertaken in 2023/24; see annex 4.1). The project team provides regular oversight of the project, reviews progress, considers problems and develops solutions. CABI collaborates closely with its partners from SHRI and ENRP to ensure the success of the project. Due to the island's remote location and limited accessibility, close collaboration among partners is crucial. The CABI team visited the island between October 2023 and early 2024 through three separate team visits covering an overall period of 7 weeks. During periods when CABI is off the island, it relies on partners to take forward activities, monitor progress and report back on results. Notably, staff from ENRP have taken the lead in monitoring disease incidence on the peaks and providing test plants for the pathogenicity experiments. A noteworthy instance of this fruitful collaboration was the establishment of a 'quarantine' shade house facility for the pathogenicity screenings. CABI outlined the necessary plans, while Martina Leo and Andy Timm from ENRP facilitated the procurement of materials and oversaw the construction of the facility. Although the construction took longer than anticipated the new facility has allowed the pathogenicity screening to commence and forms a blueprint for improving the rest of the propagation facilities to minimise the risk of pathogens spreading in the nursery facilities. A major focus in 2023 and early 2024 has been the training of ENRP staff on various aspects of plant disease diagnostics and management. Staff from ENRP have received training on sampling and using the LAMP Genie II molecular tool for identifying *Phytophthora* species in infected plant materials and pure culture. The last project year also saw training provided to a wide range of stakeholders focusing in particular on plant disease management (for details see chapter 4.1.2). In addition, Rebecca Cairns-Wicks attended the BSPP conference 6th to 8th September in the UK and visited CEH, RSPB and BiFoR and CABI (11/12 September) during a visit to the UK.

Stakeholders:

The stakeholders for the project have mostly remained the same. Some of the key stakeholders are organizations involved in biodiversity conservation on St Helena. Other projects that complement this one include 'Conserving St Helena's endemic invertebrates through invasive invertebrate control' (document number 1) and the FCDO (CSSF) funded Cloud Forest Project 'Restoring St Helena's

Internationally Important Cloud Forest for Wildlife, Water Security', with the St Helena National Trust, RSPB, and SHRI being the main project partners. Collaboration between these projects began during the first visit and has further intensified during the life of the project. A task force was established as soon as it became clear that urgent phytosanitary measures were necessary. The RSPB currently chairs the taskforce, which regularly meets with all major stakeholders participating including the GBNNSS.

Other important stakeholders are the farmers and growers as well as the wider public on St Helena. Field site visits and discussions with numerous growers continued to take place during the third team visit in October/November 2023, but the focus shifted from pathogen identification to disease management. The project remains open to sharing the outcomes throughout the project as widely as possible and encourages all stakeholders to take an active part in project planning and decision-making.

3. Project progress

1.1 Progress in carrying out project Activities

Activities during the project year 2023/24 followed those outlined in the project log frame but also took into consideration the findings from the first two project years. One significant deviation from the log frame was the shifting of the pathogenicity experiments (Output 2.1), initially planned for 2022/23 into the project year 2023/24 This delay was necessitated, due to the low germination rates and slow growth of the endemic species needed for the experiment and a delay in the construction of the 'quarantine shade house facility. Therefore, the activities linked to this had to be moved into the project year 2023/24 to allow for time to propagate the seedlings in sufficient numbers for testing. This also impacted the timing for the second visit of the PhD student Amy Webster, who visited the island twice in the last quarter of 2023 and the first quarter of 2024.

The last significant change was the movement of the second entomopathogenic fungus (EPF) survey (Output1) into the project year 2023/24 to allow for coverage of distinctively different collecting season. These changes were communicated to DI and the change request was approved. All other activities went ahead as planned with the majority taking place between mid-October 2023 and early March 2024 during the third, fourth and fifth visit by the CABI team to St Helena.

Output 1 Pathogens at the heart of emerging threats identified for the agricultural, forestry and environmental sectors.

Activity 1.1 *Collation of existing information on pathogens previously recorded on St Helena, presumed pathways of introduction and any observed or recorded impact. Preliminary listing of priority needs and gaps. Literature review conducted supported through on island research of hard copy reports and papers:* Completed in year 1; see first annual project report.

Activity 1.2 *Cataloguing of pathogens and associated vectors including those recorded during the project. This activity will be based on excel and is an ongoing process. The catalogue will remain open for further additions beyond the termination of the project.*

This activity started in year 1 but is scheduled to continue until the end of 2024. The number of organisms identified from St Helena continues to grow. Currently, there are 642 records in the database. These records include historical literature sources and samples collected and identified from the island as part of this project. Because of the large number of samples collected, it has not been possible to identify all isolates to species level. The approach taken has been to undertake an initial 'screen' of the samples using morphological identification techniques to obtain genus-level identifications. Representative isolates from known pathogenic genera were selected for molecular identification. Below is a breakdown of the samples held in the database.

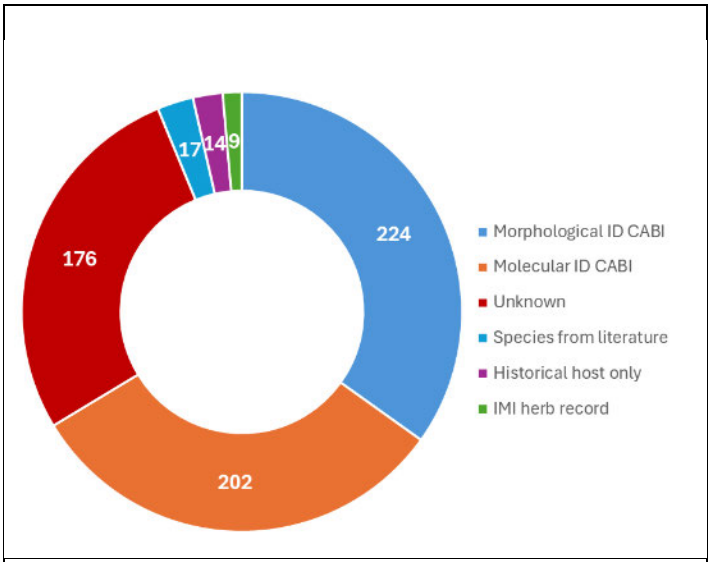

Figure2: Breakdown of plant and insect pathogens recorded from St Helena

Output 2. Current and future impact of plant pathogens on the peaks cloud forest species and economically important crops assessed

Activity 2.1.1 *Assessment of tree dieback of cloud forest trees including survey for causal agents during first survey visit in Q4 Y1 by CABI team and PhD student; species finalised by Y4 Q3*

This activity was optimistically scheduled to have been completed in year 1. Although surveys were conducted in the first year it soon became apparent that this level of activity was insufficient to identify the causal agent(s) responsible for the dieback and disease symptoms observed on the wide variety of endemic trees on the island. Further surveys for causal agents continued in 2024 to cover newly diseased and/or dying trees. These surveys will likely continue, albeit on a reduced level into the last project year. A huge diversity of organisms has been isolated from diseased plants, the vast majority of which are saprophytes or weak/opportunistic pathogens. The challenge is to identify from this diverse assemblage what are the primary pathogens responsible for disease. A good first indicator is a consistent association with diseased plants, and this can only be established through systematic sampling.

During the visits in 2023/24 the CABI/St Helena team re-visited the cloud forest in the Peaks National Park to assess and take samples from trees showing new signs of diseases and to cover areas, where dieback, had been newly observed. In January 2024 using the additional match funding from Defra new diagnostic equipment (Optigene Genie II LAMP system) was installed in ENRP's diagnostic lab at Scotland St Helena. The new molecular equipment will facilitate the rapid scanning of isolates from diseased trees for the presence of the main putative causal agent of tree decline *Phytophthora kelmanii. Phytophthora* rapid diagnostic kits were still used in parallel during the project year to get indications for the presence of Oomycete pathogens while doing survey work in the field. More details on field methods and isolation techniques are provided in the previous annual reports. In addition, four shipments of samples isolated and cultured by the team based in St Helena were sent to the CABI's facilities in Egham for identification.

Since the last annual report, more trees have started to decline or have died inside the 'Peaks National Park and Whitewood and She Cabbage trees seem to be particularly badly affected (see maps showing the assessed trees and associations with pathogens in annex 4.6). Additional sampling focused on the 'George Benjamin's Arboretum' where a significant number of trees have now succumbed to disease(s) and several She Cabbage and Whitewood trees tested positive for *Phytophthora kelmanii.* In 2023, this site also provided the first record of *P. kelmanii* associated with the endemic Black Cabbage tree.

All isolates were taken to CABI UK under Defra licence for identification. The isolates from the trips undertaken in October/November 2023 and January to March 2024 are still in the process of being identified and a full technical assessment report will be produced in Y4.

Figure 3: Dying trees at Black Gate field gene bank in January 2024

Figure 4: Internal discolouration seen in dying Whitewood (*Petrobium arboretum*) at Black Gate field gene bank in January 2024

Figure 5: Dead Whitewoods (*Petrobium arboretum*) in the George Benjamin Arboretum in January 2024

Figure 6: Taking samples from a diseased whitewood at Bellflower Ridge in the Peaks National Park, January 2024

To date, several potential pathogenic genera have been identified from diseased endemic trees these include *Phytophthora, Pythium, Fusarium, Ilyonectria, Erwinia* and *Xanthomonas* bacterium added during 2023/24. To confirm pathogenicity, Koch's postulates must be fulfilled, which involves inoculating healthy plants with isolates and subsequently recovering them from diseased plants. The pathogenicity testing was conducted in St Helena where the endemic test plants are being grown and the environmental conditions are most like the Peaks. However, the testing can only take place once sufficient test plants have been grown and a quarantine shade house has been constructed to accommodate the experimental trails.

In the meantime, a pathogenicity trial was conducted in early 2023 in the UK using six garden plants related to the target tree species on St Helena (Tomato, Marigold, *Dhalia*, *Zinnia*, *Chrysanthemum* and *Agryranthemum*). The testing was designed to develop and refine a suitable methodological inoculation approach for use on the Island. *Phytophthora kelmanii* and *Ilyonectria* spp. complex isolates were tested on plants inside the quarantine facilities at CABI Egham, UK. The inoculum for the *Phytophthora* was prepared by growing the *Phytophthora* isolate on autoclaved rice grains. The inoculation was achieved by making holes in the soil and placing 5 rice grains into each pot. For the *Ilyonectria,* a conidial suspension was prepared from pre-colonised plates and applied to the pots as a soil drench. Negative controls consisted of sterile rice grains and sterile distilled water. The experiment was monitored over an eight-week period during which 2 of the 3 inoculated *Argyranthemum frutescens* (Marguerite Daisy) plants showed signs of wilting and root death. The

controls remained healthy. This was the first positive evidence that the *P. kelmanii* isolate from St Helena was pathogenic albeit to a plant species in the same family as those on St Helena. The *Ilyonectria* isolate did not illicit any above-ground symptoms, although there was some minor discolouration of roots.

A risk assessment for the reimportation of the relevant pathogen isolates required for testing was conducted and the import back into St Helena was subsequently granted by the biosecurity authorities on the island. However, due to the scarcity of endemic tree seeds on St Helena, low germination rates, and the long time required for their growth, tree seedlings for the planned experiments only became available in early 2024. In addition, quarantine facilities to safely conduct inoculation experiments had also to be installed. The erection of a purpose-built quarantine shade house became possible after securing additional matched funding from Defra and took place during 2023. The first in-country pathogenicity trial was set up in February 2024. Thirty whitewood (WW) seedlings were inoculated with *P. kelmanii* and an *Ilyonectria* isolate (15 each) and due to limited availability of dogwood seedlings only *P. kelmanii* were included in the trial. Two different levels of inoculum of *P. kelmanii* and *Ilyonectria* were used (low and high) as well as a control. The treatments were as follows:

1. 5 WW plants sterile rice = *Phytophthora* Control
2. 5 WW plants 5 grains of inoculated rice = *Phytophthora* low
3. 5 WW plants 5 grains of inoculated rice = *Phytophthora* high
4. 5 DW plants sterile rice = *Phytophthora* Control
5. 5 DW plants 5 grains of inoculated rice = *Phytophthora* low
6. 5 DW plants 5 grains of inoculated rice = *Phytophthora* high
7. 5 WW plants sterile water = *Ilyonectria* Control
8. 5 WW plants *Ilyonectria* dilute (10ml of 10^6 conidia/ml) = *Ilyonectria* low
9. 5 WW plants *Ilyonectria* concentrated (10ml of 10^7 conidia/ml) = *Ilyonectria* High

The seedlings were inoculated using the methodology developed in the UK glasshouse experiment and maintained in the shade house. After four weeks, four whitewood seedlings inoculated with *P. kelmanii* (two with 5 grains of rice and two with 15 grains of rice) showed signs of wilting and necrosis of the roots (Fig. 9 and 11) with the control plants showing no symptoms (Fig. 10 and 12). *P. kelmanii* was reisolated from the washed roots of the inoculated whitewood seedlings and not from the control plants thus confirming Koch's postulates and that *P. kelmanii* is capable of rapidly killing Whitewood. The remaining non-symptomatic whitewoods inoculated with *P. kelmanii* were uprooted and examined at the end of the trip – although no wilting symptoms were observed the roots in the treated plants were reduced in size and rotted and the control plants healthy. *P. kelmanii* was reisolated from all the *P. kelmanii* treated plants. DNA was also extracted from all of the seedlings; seedlings inoculated with *P. kelmanii* all tested positive using LAMP + *Phytophthora* Clade 8a primers, all of the controls tested negative. The *Ilyonecteria* inoculated whitewood seedlings appeared to be healthy at the end of the trial, no symptoms were observed and *Ilyonectria* was not isolated from either the treated or control root tissue.

The dogwood seedlings treated with *P. kelmanni* showed no above-ground symptoms of wilting or stress regardless of the *Phytophthora* inoculation. Moreover, on examination of the roots, all looked to be reasonably healthy however there was some light discolouration on the Phytophthora-treated plants. One of the Dogwood's controls had wilted, whereas the other three remained healthy. On closer inspection of the wilted control, there was a lesion seen in the collar region, and on isolation, the fungus responsible appeared to be a *Fusarium* sp. that has been sent for identification.

A second pathogenicity trail was set up in early March, using Whitewood, Black cabbage and She cabbage plants. In this experiment, only *P. kelmanii* inoculum was used at the higher concentration. The experiment is ongoing at the time of this report writing. The biggest constraint to further testing is the availability of test plants. The endemic species that we would like to test are all endangered, have low germination rates, or are slow growing.

Figure 7: Newly erected quarantine shade house at Sunnyside, Scotland, St Helena.

Figure 8: Whitewood and Dogwood seedlings ready for inoculation at the newly erected shade house at Sunnyside 2024.

Figure 9: Whitewood inoculated with *Phytophthora kelmanii* showing symptoms of wilting one month after the start of the experiment.

Figure 10: Whitewood control inoculated with sterilised rice granules showing no signs of a diseases one month after the start of the experiment.

Figure 11: Whitewood inoculated with *Phytophthora kelmanii* showing necrosis of the roots.

Figure 12: Whitewood control inoculated with sterilised rice granules showing healthy root system.

2.2.2 Second onsite survey of crop and forestry pathogens as well as EPFs

The second survey of crop and forestry pathogens was completed as planned in the second project year 2022-2023; for details see the last annual project report. However, to cover a different season and potentially obtain different pathogens, the second survey for EPF was shifted into the third project year after a change request. This was conducted by Harry Evans between the 11th and 29th of January 2024. This survey included revisiting sites in the cloud forest most likely to yield new discoveries during a different season to the first visit. Due to the access restrictions in place, every group of scientists had to be accompanied by an ENRP officer at all times. This meant that the EPF survey had to be bundled with sites visits aiming to take samples from diseased endemic trees. Some sites outside the Peaks National Park including the Millenium Forest, Plantation Forest and Blue Hill were also revisited. Additional sites surveyed for the first time included Cason's, Fisher's valley, High Hill and Napoleon's tomb. Details about the surveying and sample processing methodology are provided in the previous annual report. As before, after further examination at CABI-UK, the specimens were assigned temporary codes until final accession in the CABI fungarium (Herb IMI, now housed at RBG Kew). Fungal isolates from the survey were sub-cultured and then transferred to storage tubes for deposit in the CABI Culture Collection. All these accessions will receive IMI codes as official deposits. An annotated list of the EPFs collected during January 2024 including figures is provided in annex 4.3. Some of the collection still remains to be identified and, thus, the fungal-host list provided in the annex is still provisional. The two surveys conducted during the project remain only a snapshot of the EPF present on St. Helena. Their occurrence will vary during the year, according to the season and prevalent weather conditions. However, as shown here, more new records – and, potentially, new species – continue to be discovered: equally, of course, this also applies to the plant pathogenic fungi, especially of the endemic plant species. In order to confirm the novelty of these collections, additional molecular data will be needed, and it is planned to obtain this in the coming months. The surveys indicate that, like the flora and fauna, the mycobiota of St. Helena is also highly diverse with a richness of species, some of which could also be critically endangered and at risk of extinction, along with their arthropod and plant hosts. The interactions of these fungi with their hosts and their roles in ecosystem functioning remain to be determined.

The second survey also confirmed that some species of endemic leafhoppers (*Sanctahelenia insularis* – a critically-endangered species – and *Atlantocella leleupi* – a vulnerable species, fide Key et al., 2021) are under threat from an, apparently, exotic species of *Beauveria*, close to if not identical with *B*. *malawiensis*; which was also collected on several occasions on the introduced flax weevil (for more detail see previous annual report). There remain some puzzling questions to answer:

- Why has this EPF not been found on other leafhopper species, notably, *Sanctahelenia decellei*, which is 'out-of-control' and causing significant damage to its gumwood host; especially in the Millenium Forest.
- Why has it only been found on the flax weevil and not on other beetle hosts; and does it pose a threat to endemic species of Coleoptera – as well, of course, to the two endemic leafhoppers
- How and when did it arrive – this EPF has never been produced as a commercial mycoinsecticide and, therefore, it must have arrived accidentally on St. Helena.

During the second EPF survey more samples of the unknown *Aschersonia* species on the two yet undescribed and possibly endemic whitefly species from Whitewood and Dogwood were obtained and in the coming months molecular assessments are planned to ascertain whether two separate EPF are involved in this St Helena specific host pathogen system.

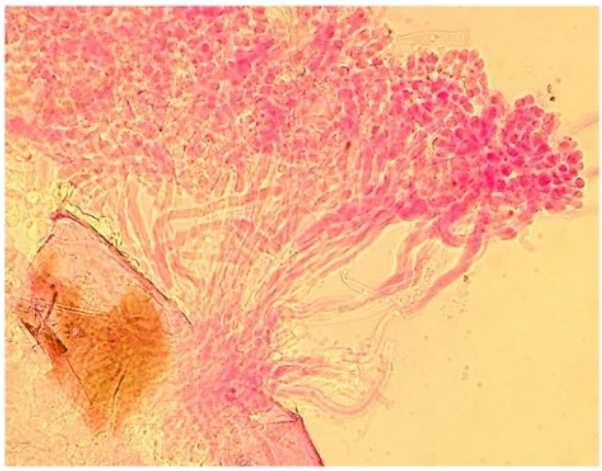

Figure 13: *Erynia* sp. ined., on leafhoppers, *Sanctahelenia decellei* (Cicadellidae), on gumwood *(Commidendrum robustum, Asteraceae);* conidiophores bursting through exoskeleton

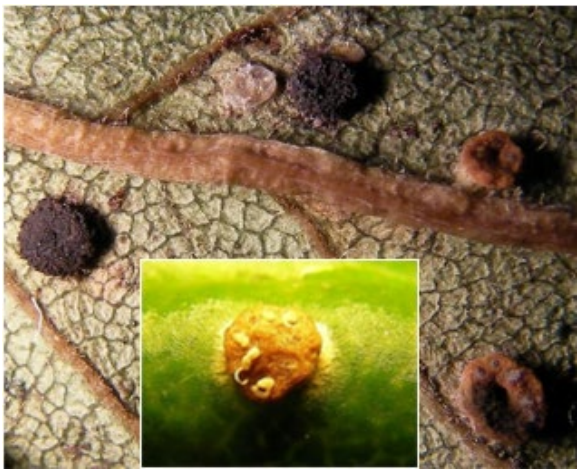

Figure 14: *Aschersonia* sp. ined., on whitefly nymphs (*Aleuroplatus* sp. 2; Aleyrodiidae), on leaves of whitewood (*Petrobium arboretum*). Stromata of *Aschersonia* colonised and overgrown by black crusts of mycoparasites; inset shows a healthy *Aschersonia* stroma exuding white spore tendrils

Figure 15: *Hirsutella* sp. ined., on Psocoptera on leaves of shrubs (Rubiaceae)

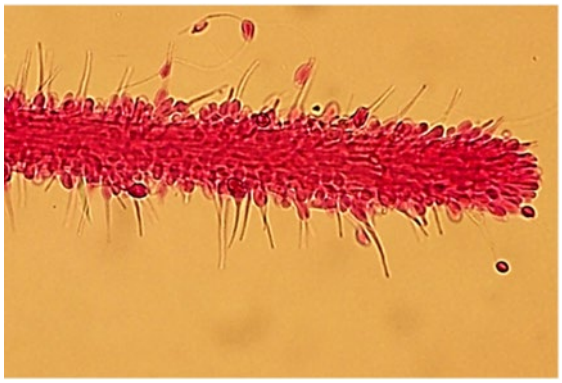

Figure 16: Details of conidiogenous structures on synnema of *Hirsutella* shown in fig. 18

The following activities have all been completed during the first two project years; for details see previous annual project reports:

2.1.2 Second on site survey for tree pathogens by BIFoR PhD student
2.1.3 Processing of samples and development of assessment report
2.2.1 First onsite survey of crop and forestry pathogens as well as EPFs including farmer interviews
2.2.3 Processing of samples and development of assessment report

Output 3. Action plan to mitigate identified threats developed with and made available to all stakeholders (this will include different chapters addressing the identified threats for each sector and a strategy for future management)

3.1 *Action plan finalised by Y2 Q4; the participatory approach documented through meeting protocols with stakeholders*

The survey of crops and forestry species on St Helena found surprisingly few plant diseases on St Helena, most of which do not require specific interventions. Exceptions to this were *Pythium lutarium* on tomato and *Pseudomonas cichorii* on lettuce that were found to significantly impact production for the domestic market. The problem was identified during the first year of the project and once the pathogens were confirmed a management plan including a wide range of recommendations to address this problem was developed in 2022 and subsequently implemented in early 2023. By

October 2023, the production of tomatoes had recovered, and the improved production system will avoid future yield losses caused by these diseases. The management plan for tomato and lettuce production on St Helena is attached to this report as annex 4.4.

Regarding the tree dieback, it is currently too early in the project to come to any conclusive and comprehensive conclusions on treatments and best practices. This is because such decisions can only be made based on knowledge of the pathogens that have been identified through surveys and pathogenicity experiments. These experiments are still ongoing, and therefore, we cannot make any definitive statements at this time.

Despite this delay, the discovery of a range of serious soilborne plant pathogens within the Peaks National Park has already led to the formation of the task force involving all major stakeholders active in St Helena. In 2022 the task force implemented emergency measures to restrict access to infected sites or sites particularly sensitive for conservation. Other measures include detailed phytosanitary protocols, which all personnel working in the vicinity of infected or sensitive sites are required to adhere. Access restrictions were widened in 2023 to include public access to the entirety of the Peaks National Park. Exemptions from these restrictions are only granted for essential activities, contingent upon a substantiated request to SHG. This has become applicable also to activities conducted by the team working on this project. Based on advice given by CABI pathologists, the Cloud Forest Project team have developed a management protocol to produce disease-free tree seedlings. This was urgently needed for efforts to restore the cloud forest on St Helena. They are also essential for the conduct of the remaining pathogenicity experiments, which are required to confirm if the pathogens discovered during our surveys as causal agents for the ongoing tree dieback.

The first results from the pathogenicity experiments have now confirmed *Phytophthora kelmanii* to be the causal agent behind the demise of at least one endemic tree species (Whitewood) and this has allowed us to review the measures currently put in place. The resulting draft action plan is attached as annex 4.5 to this report. The recommendations made in this draft have been made available to ENRP for their consideration and pave the way for a decision on the tentative reopening of the Peaks National Park to the public, providing a range of safeguarding procedures and regulations are put in place. It is important to note that a comprehensive action plan will only be finalised once the results for additional tree species and pathogens become available.

Output 4 Capacity for St Helena to address threats caused by pathogens independently increased

4.1.1 Development of training material based on action plan

The training provided by CABI as part of the Plantwise program has been widely tested in many countries and was the basis for the training given in St Helena. The material was modified to fit a shorter timeframe and cater to the needs of participants on St Helena. It was also adjusted to suit the requirements of both forestry and extension/conservation staff. Although this activity was mostly completed during the previous year, additional training materials were developed focusing on disease management. The training activities were conducted in October 2023.

4.1.2 Three workshops held on St Helena to train relevant stakeholders in diagnosis of diseases and best practice for efficient control.

The training provided in 2023 was given on four different locations and for five different audiences. Whilst bespoke to each event the training was all a version of the Plantwise module 2 “Giving good recommendations”. This course has been tried and tested in many countries across the globe and is always well received. The previous training in 2022 at SHAPE (St. Helena's Active Participation in Enterprise) had provided a lot of good will on the island and therefor it was decided that the second part of the training would also be provided. This training over about 4 hours was well received by the staff, volunteers, and residents. 9 people were trained in total (3 women and 6 men). Whilst visiting SHAPE, practical advice was provided on managing the pests and diseases they face in their cultivation systems. A much more technical training was provided to the staff of ENRP. This training

was provided over 2 days (2 men and 8 women) within the Scotland laboratory complex. The training investigates aspects of pest management, the economics of pest management as well as the various options and timings with regard pest and disease control. Biological control and cultural methods are promoted along with safety when considering chemical control. Literature pertaining to chemical use to ensure efficacy and prevent the development of resistance was supplied along with information on the appropriate phytosanitary methods to use when dealing with the various pathogen and pest groups. The feedback from the course was very positive. A reduced version of the course was given to farmers and agro input importers/ suppliers one evening. Once again, the practical nature of the course was well received by the participants. The literature on chemical resistance groups and regimes to reduce the development of resistance in insect pests and pathogens was of particular interest. Training was provided to forestry and conservation workers in the training room of the Scotland nursery (16 men and 1 woman). Although the course is primarily for pest and disease management in crop production it was adapted to include arboriculture where possible.

Summary of results from the feedback forms after "Giving good recommendations" course given to ENRP staff.						
	5	4	3	2	1	NA
	Strongly agree			Strongly disagree		
1. I learned new knowledge skills from the course	8	2				
2. I am confident in my ability to use the knowledge skills learned from the course	4	5	1			
3. The course was a worthwhile investment for my organisation	8	2				
4 The course was relevant to my work	7	2				
	High extent			Low extent		
5. to To what extent will you apply the knowledge skills learned from the course	7	3				
6. How will the knowledge skills learned influence your job performance	5	5				
	Very important					
7. How important is the use of the content of the course to the success of your job	7	2	1			

4.1.3 Student and community engagement through trial plot at Prince Andrews School; ongoing supervision onsite by SHRI and ENRP

As mentioned in the previous annual report trial plots were considered inappropriate and were not set up. However as for 2022 training was provided for the students of Prince Andrews school at their agricultural classroom at Harpers. A total of 14 students were trained in two batches of 7. They comprised 10 boys and 4 girls in total. The training was based around the module two of the Plantwise training "Giving good recommendations" which has been delivered and well received across the globe The training was modified so as to be inspirational, educating the students in methods of disease and pest control and revealing the true extent of natural biological control that takes place under field conditions. Safety pertaining to chemical use was touched upon.

4.2 Improvement of laboratory facilities for diagnostic of pathogens and/or preparation of samples for shipment for external identification. Final review of material and equipment list in Q3 Y1 immediately after project approval; order of new equipment in Q3 Y1 to allow equipment to arrive prior to first site visit; shipment and instalment until Q2 Y2

Although this activity was formally completed in the second project year, significant advancements were still achieved in 2023. Secured matched funding facilitated the establishment of additional capital equipment in the renovated laboratory at Scotland, enhancing its capabilities. The new

equipment included an Optigene GenieII LAMP system for molecular diagnostics work. This became necessary to enable a more rapid diagnosis of tree pathogens by the team on St Helena. This, to a large degree, replaces the time-consuming and costly shipment of samples to the UK for identification. The new system will enable the St Helena team to verify the identity of pathogens utilized in the pathogenicity experiments, thus confirming Koch's postulates. Moreover, this development is crucial as it will enable newly produced tree seedlings to undergo disease testing before their transplantation at restoration sites.

Figure 16: Setting up of the Optigene GenieII LAMP system at Scotland, St Helena.

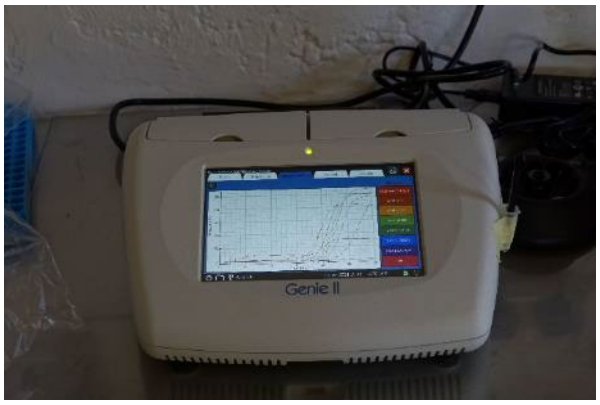

Figure 17: Close-up of the Optigene GenieII LAMP system setup at Scotland, St Helena.

4.3 First onsite training of at least 6 staff in using improved diagnostic facilities & online tools; established Plantwise test applied before and after training to measure the increase in knowledge by an increase in the score on the two tests in Q4 Y1; further onsite supervision of trained staff during follow on CABI team visits Q2 Y2, Q4 Y2 and Q1 Y4

A large part of the training was already provided within the first two project years. Further training was provided to 5 staff from ENRP/SHRI during 2023/24, this built on previous training and included the use of the newly installed LAMP system. On the job training took up considerable time but was essential to allow independent pathogen surveys and assessments to be conducted by the team based on St Helena. Within the project, 7 people have been trained in using diagnostic procedures for identifying diseases in plants. As well as protocols for using the LAMP machine and carrying out the pathogenicity testing several CABI manuals were shared with the team in St Helena to aid with laboratory techniques and basic fungal identification:

- Identification of environmental fungi
- Mycological techniques
- Plant health diagnostics: An introduction to fungi
- Plant clinic handbook

These manuals are proprietary and have therefore not been included in the Annex.

1.2 Progress towards project Outputs

1. Pathogens at the heart of existing and emerging threats identified for the agricultural, forestry and environmental sectors.

A systematic review of existing literature and other knowledge sources was conducted to identify plant pathogens from St Helena. The review yielded just 40 records, which served as the starting point for the development of the database of St Helenian plant pathogens. The first indicator for this output was that “1.1 at least 50 searchable records of pathogens and their hosts recorded in St Helena accessible in a newly developed Excel database, by end of Y1”. This indicator was achieved within the first year of the project and reported on in the first annual report. The second indicator “1.2 number of records held in database increased year on year exceeding 300, by Y4 Q3” refers to the continuing

development of the database and has set a target of more than 300 records by the end of the project. The project is well on track to achieve this. The five visits to the island during the project have so far generated more than 60 samples identified from crop plants and 500 from endemic vegetation. Notable inclusions in 2023 were an undescribed *Ramulariopsis* species on the endemic Jellico (*Sium bracteatum*) and a rust pathogen on Whitewood, which in all likelihood will turn out to be an undescribed new species co-evolved with and specific to its host.

In addition, 12 entomopathogenic fungi have been collected and identified from endemic and introduced insects and spiders during the second EPF survey in early 2024. This includes 6 newly discovered species and brings the total of recorded EPF to 24, details of which can be found in in annex 4.3. A significant number of identifications are to genus level only and the database is constantly being updated as species-level identifications are made. Due to the large number and variety of samples collected, it is not feasible to identify all isolates. Nonetheless, pure cultures of fungi are being deposited for long-term preservation in the cryopreservation unit at CABI, ensuring they are accessible for future research. The database will greatly enhance our understanding of the pathogens present on the island, and the project remains on schedule to deliver a comprehensive database by its conclusion. As a dynamic and ongoing resource, the database will continue to evolve and expand beyond the duration of the project as new findings are made and documented.

A new tool introduced to the project in 2023 is a second database allowing precise mapping of individual endemic trees, their state of health and linkages to pathogen isolated. This will be instrumental in monitoring the spread of pathogens in the coming years. The new database is hosted by the SHRI.

2. Current and future impact of pathogens on the peaks cloud forest species and economically important crops assessed.

The assessment of crop pathogens was largely completed in the first two project years and only little additional progress has been made in 2023/24. Our initial two surveys of the diseases of agricultural crops indicated that many common, what could be considered ‘universal’ crop pathogens, were absent from the island This was true for most of the important outdoor crops such as coffee and bananas which were almost free of disease, despite no attempts to control pathogens (for more details, please see the previous annual report). Significant problems have been observed in indoor lettuce and tomato production, primarily stemming from oomycetes and bacterial infections. The first indicator for this output is “2.1 at least one plant pathogenic taxon each affecting endemic tree species and agricultural crops to be identified by Y3, Q3”. The identification of the key pathogens responsible for losses in lettuce and tomato production addresses the agricultural component of the indicator (see annex 4.4 which describes the implementation of the management plan to address these problems and improve crop yields).

The situation for the dieback of endemic trees is considerably more complicated. Efforts to identify isolated pathogens at CABI are still ongoing, with several potential pathogenic genera already identified, including *Phytophthora, Pythium, Fusarium, Ilyonectria, Phomopsis and Erwinia.* In 2023/24 we discovered bacterial infections associated with a tip dieback on He cabbage and Black cabbage caused by a *Xanthomonas* sp. The association of an organism with a diseased plant is not proof of pathogenicity as many organisms are capable of colonising dead plant tissue but lack the ability to initiate disease in healthy plant tissues. Pathogenicity can only be proven through inoculation experiments and the confirmation of Koch’s postulates. The pathogenicity experiments conducted in 2024 allowed us to confirm *Phytophthora kelmanii* to be the causal agent behind the dieback of Whitewood (*Petrobium arboretum*). This is a significant breakthrough as *P. kelmanii* has been suspected to be one of the main causes of the tree dieback in the St Helenian cloud forest, if not the most important one. Whitewood is also the endemic tree species most impacted by the tree dieback. This progress was possible through the availability of a sufficient number of disease-free seedlings, which finally became available for pathogenicity testing in early 2024. At present, our primary focus is on securing the essential resources needed to successfully carry out this critical activity. This includes expanding our efforts to encompass a broader spectrum of tree species, both native and non-native plants, and addressing additional pathogens. Once completed, this will provide crucial insights into the severity and scope of the disease threats posed by these pathogens and will better

inform a final version of the disease management plan. The second indicator "2.2 Impact of the two most threatening pathogens quantified using a combination of disease severity and potential dispersal pathways by Y3Q3" can only be addressed once the pathogenicity, host range and biology of the organisms responsible for disease have been defined. The Peaks Cloud Forests is a unique habit that has not been extensively studied for fungal biodiversity. Many of the species isolated in this project are poorly described or new to science. For species like *P. kelmanii*, which was first described in 2020, limited literature exists regarding its biology. Therefore, some of the necessary information to assess its impact may need to be inferred from knowledge of closely related species as the testing required to gain this knowledge is beyond the scope of this project. The remaining two indicators 2.3 and 2.4 concern the profiling of the potential impact of the pathogenic taxa found in the project. In the case of 2.3 this is on economically important crops and endemic tree species whereas 2.4 refers to the threats and benefits for endemic invertebrates. The project is on course to deliver on these indicators although much like 2.2 some of the assessment may need to be inferred given the unique nature of the pathogens.

Overall, despite delays in pathogenicity testing the research is still on track to deliver on the output indicators however, given the potentially complex nature of the tree decline there is no guarantee that the project will come up with a definitive identification of all organisms and interactions involved in the decline of the endemic species.

3. Action plan to mitigate priority identified threats developed with and made available to all stakeholders.

This output aimed to identify management options to address the impacts of the most important plant pathogens on crop production and those affecting the endemic trees in the Peaks National Park. The verification indicator for this being the adoption of improved management practices for at least 4 priority threats to cloud forest species and/or economically important crops. Good progress has been made concerning economically important crops grown on St Helena. A management plan was developed and adopted by the grower to improve the phytosanitation for the indoor production of tomato and lettuce. A report on this is attached as annex 4.4.

A phytosanitary regime was proposed early in the project to minimise the potential for the accidental transfer of pathogens from one region to another. This regime has been adopted by the ENRP. The confirmation of *P. kelmanii* as a causal agent of the dieback of Whitewood has allowed the development of a draft management plan to mitigate the impact of this devastating plant disease in the Peaks National Park (annex 4.5). As the cause(s) of the disease(s) in other endemic tree species are still unknown it is not yet possible to provide detailed information on comprehensive mitigation strategies for threats to the cloud forest. Therefore, the current draft will undoubtedly have to be updated during the final project year. However, there are principles of phytosanitation based on our current knowledge that can already be applied which will already reduce the overall threats.

4. Capacity for St Helena to address threats caused by pathogens independently increased.

The training supplied in 2022 was supplemented by that of 2023. These two training sessions will have increased the capacity for local people to diagnose and to manage pests and diseases in a timely and appropriate manner and fulfils the indicator "*4.1 At least 30 stakeholders (disaggregated by gender, age, etc.) proficient in the diagnosis of diseases and best practices for effective control by Y3Q4".* The 2022 training will have increased capacity to diagnose problems and that of 2023 will have increased capacity in how to prevent them and to manage them should they occur. The training at Prince Andrew School may have inspired some students to become interested in crop protection and may take up a career in that discipline accordingly. The training provided to farmers and agro input suppliers will have encouraged the uptake of newer crop protection chemicals which are less toxic and less damaging to the environment than the older chemistry.

A major step towards this output has been achieved through the refurbishment of the pathology lab at ENRP (St Helena; Scotland site) with a comprehensive set of equipment necessary for the isolation and morphological identification of pathogens (indicator *4.2 Number of new pieces of Laboratory equipment and consumables added to the ENRP research laboratory by Y2Q4*). Seven staff from

ENRP have been trained in the use of the equipment for processing samples of crop and tree diseases (indicator *4.3 At least 6 staff trained in the use of diagnostic facilities and able to independently isolate and diagnose plant diseases by Y4Q1).* New cutting-edge DNA detection equipment (Optigene GenieII LAMP system) was installed in St Helena between January and March 2024 and comprehensive training was given to 5 staff on how to use it. Where local expertise is not yet sufficient, there is the capacity to take digital photomicrographs and send images to CABI for identification. This work successfully addresses the indicators.

5. Pathogen treatments implemented.

This output has been achieved regarding the crop production sector, as described further above, with significant advancements in phytosanitary procedures observed in indoor vegetable production. Consequently, food security for high-value salad vegetables like tomato and lettuce has been notably enhanced. These achievements align with indicators 5.1 At least one new treatment measure was developed and tested during Y3Q2 to Y4Q2. And 5.2 At least one new treatment practice(s) demonstrates a quantifiable reduction in the spread and/or severity of disease, by Y4Q3, demonstrating the development and successful testing of new treatment measures, as well as the quantifiable reduction in disease spread and severity.

Due to the undetermined causes of the problems on the endemic trees, it was not possible to provide comprehensive recommendations for treatments at this stage. However, advice was provided for improving the phytosanitaion and growth conditions of the seedlings in the nursery in Scotland and a draft management plan has been drawn up. A full action plan is now envisaged to become available by the end of the project as soon as the outstanding results of pathogenicity testing have been obtained.

1.3 Progress towards the project Outcome

Outcome: *St Helena will have an increased local capacity to manage plant and insect pathogens reducing the risk of biodiversity loss and increasing economic prosperity.*

During the first three project years (year 1 comprised only 6 months) the team has made five visits to the island and collected and identified samples from endemic, forestry and agricultural plants found in a range of habitats. In addition, a pathology lab has been set up and laboratory training given to local staff for the identification of plant pathogens. Training has also been provided to as wide a range of stakeholders as possible covering initially the diagnosis of plant diseases. A major focus of the third project year was on providing training to growers and other stakeholders in disease management and five workshops were held in October 2023. A further focus has been to implement emergency measures to prevent the further spread of potentially serious pathogens belonging to the oomycetes after their initial detection in 2022. The urgent need for improved phytosanitation in the Peaks National Parks led to the closure of the Peaks to the public and the development of a *Phytophthora* taskforce led by local stakeholders but with scientific inputs from CABI. The Peaks closure has had significant knock-on effects on other research projects and conservation activities currently ongoing on St Helena. The detection of pathogens in the nursery production site in Scotland has led to the implementation of improved Phytosanitary practices and a draft protocol produced by ENRP but with Inputs from CABI. This protocol should lead to the production of healthier nursery stock and limit the further spread of disease on the island. The newly built quarantine shade house constructed with match funding by Defra provides a blueprint for how plants should be grown and maintained going forward. The pathogenicity of one of the putative agents, *Phytophthora kelmanii*, has been confirmed for the endemic Whitewood, the tree species most affected by the tree dieback. This has allowed the drafting of a preliminary management plan and putting in place precautionary phytosanitary measures. These interventions have had a significant impact on the production of nursery stock and will inform future restoration efforts. Taken together they directly address the first indicator 1.1 ‘Changes to habitat management practices in cloud forest, and afforestation’s based on best practice recommendations. Healthier nursery stock in production by the end of the project’.

Further inoculation experiments on additional tree and other plant species as well as tests using other pathogens are planned for the last project year. This is due to the fact, that only now can disease-free seedlings be produced after the installation of new phytosanitary facilities and procedures.

The assessment of pathogens affecting crop production in St Helena has largely been completed. Management plans for combating pathogens affecting the indoor production of lettuce and tomato have been written and significant improvements observed due to their implementation. These plans directly address the second outcome indicator 2.1 which is the reduction in reported crop failures due to disease. However, the focus of project activities has moved away from the assessment of crop pathogens towards the detection and management of diseases affecting the endemic vegetation of the Praks National Park. This has become a priority given the continued death of endemic trees and the fragile nature of the unique vegetation of St Helena. Without the appropriate phytosanitation, conservation and management practices being put in place there is a significant risk of the further decline or even extinction of already endangered species as well as the communities they support.

Another positive outcome of the project is an increase in local capacity to diagnose and manage plant pathogens and insect pests, this has been achieved through upgrades made to the diagnostic laboratory facilities and training given to laboratory staff and those charged with managing the peaks. The surveys undertaken on the island by CABI, SHRI and ENRP staff and the laboratory isolations and identifications will contribute greatly to the knowledge of fungi on the island. The indicator linked to this work was 1.3 'Increased lab diagnosed diseases from the current level, 3, to 15 by the end of the project'. It is anticipated that by the end of the project, the number of lab-diagnosed plant pathogens on St Helena will have increased.

Despite delays in the pathogenicity testing of endemic plants, the project's activities are still progressing as planned and the outcome is expected to be delivered as scheduled. The indicators broadly capture the desired outcomes. It is important to note, however, that it is still too early to provide evidence of the full delivery of the outcome. Moreover, a slowed or reversed loss of trees due to the measures put in place will only become apparent years after the termination of the project.

1.4 Monitoring of assumptions

The delayed start of the project means that this annual report covers 30 months rather than 3 years. Nevertheless, the project has made good progress and several putative plant pathogens have been identified in association with the dieback symptoms observed on endemic plants. The association of these species with dying trees does not prove that it is the cause of the death and decline. Therefore, an important part of the project is to provide experimental proof of pathogeny. This can only be achieved by replicating disease symptoms on previously healthy tree seedlings through inoculation with the pathogen. Initially, this experimental step has been delayed due to the lack of seedlings in St Helena for inoculation purposes. This delay has been addressed by a change request, approved by the DI in January 2023, to undertake testing in the financial year 2023/2024. This did not require changing risks and assumptions and was addressed through an updated activity planner and small changes to schedules in the log frame. Pathogenicity testing was conducted during the last project year, but further experiments still need to be set up in the coming year. Work on these will be covered through complementary matched funding currently in the process of being secured.

Assumption 1: Sufficient baseline data on crop losses due to pathogens is available to allow comparison of changes due to improved management practices. This assumption was found to be incorrect as there was virtually no data in the literature or on the island relating to losses incurred due

to pathogens. To address this, during the second field visit in October 2022, key informant interviews were conducted with growers to get baseline data for comparison. This assumption remains a challenge as the local growers were mostly unable to give exact enough figures about yield or yield losses caused by specific diseases to allow the development of suitable baseline data.

Assumption 2: There are no outbreaks of Covid on St Helena that will cause significant disruption/delay to project delivery and there are no new variants in the UK that will result in a change to the current quarantine restrictions. By the time of the second visit to the island, there were no travel or other restrictions in place on St Helena or the transit country South Africa.

Assumption 3: Identified stakeholders, including women, are available to participate in project activities. So far, all stakeholders have been committed to the project activities. The project continues to ensure that activities including any training are conducted flexibly to accommodate the commitments of stakeholders.

Assumption 4: All partners and their staff deliver timely on their commitments to the project. Interactions with the partners have been very good and the project team meetings and Project Governance according to Prince 2 methodology help to ensure that engagement is maintained.

Assumption 5: Applied research is approved by the St Helena Research Council. The project has been designed and developed with local authorities and reflects locally identified needs and priorities. To date, we have had good support from the St Helena Research Council and have not encountered any problems.

Assumption 6: Archived literature exists that describes the plant pathogens of St Helena and is freely accessible. This assumption was found to be inaccurate. Unlike the botany and insects of St Helena which have been widely studied and documented, there is very little literature, paid for or otherwise on microbial pathogens. This makes the Excel database we are creating even more important and relevant.

Assumption 7: Export licenses for pathogen samples in place to allow identification at CABI & UoB facilities in the UK. This has not proved to be a problem and export licences have been applied for in a timely fashion.

Assumption 8: Access to the infected parts of the infected trees is easily possible. Given the protected nature of the endemic trees, destructive sampling has been kept to a minimum. There was some initial reluctance to allow sampling for pathogenic organisms, especially those affecting internal plant structures. This has largely been overcome as many of the diseased trees are in a late state of decline and unlikely to survive. The recording of potentially pathogenic fungi and oomycetes during this project has led to a strict quarantine being implemented in the Peaks area and restricted access to sensitive areas. Further surveys in the Peaks National Park during 2023/24 required a more coordinated approach and approval of the St Helenian authorities before every field site visit. However, this turned out to be unproblematic as the project involved all relevant stakeholders involved in the management of the national park.

Assumption 9: Local farmers are willing and keen to engage and share their local knowledge. To date, farmers have been willing to share information with the research team. This has been facilitated by efforts made to communicate with them about the project and the potential benefits. No change to this is required.

Assumption 10: Timing of travel to and from St Helena is not disrupted by COVID 19 or adverse weather conditions. By the time of the second visit to the island, there were no travel or other restrictions in place on St Helena or the transit country South Africa.

Assumption 11 Standard diagnostic procedures do not allow for the measurement of the current spread of pathogens. The project will draw on external specialist advice in cases where unusual methods need to be employed. The causal agent(s) have proven extremely challenging to identify using molecular means. The *Phytophthora* which has been strongly implicated with tree decline, belongs to a complex of very closely related and inbreeding species identified as Subclade 8a. To assist with identification support has been sought from external *Phytophthora* experts. The newly acquired LAMP GENIEII allows for the rapid identification of Phytophthora belonging to SubClade 8a, but is yet unable to distinguish between species within this clade. Moreover, this system does not appear to be sensitive enough to detect Phytophthora from soil samples. Further refinements are still being made to improve this system, however, other molecular methods such as qPCR will likely need to be introduced for soil sampling and these are being investigated through complementary funding from Defra.

Assumption 12 Treatments and best practice procedures are available or can be developed based on existing knowledge of the pathogens newly identified and recorded for St Helena. Suitable treatments were available to deal with the outbreaks of plant diseases within the indoor production of vegetables and these have already been implemented. Regarding the tree dieback in the Peaks National Park, it is still too early in the project to recommend definitive treatments or best practices. This will become possible when a better understanding is gained of the pathogenicity and spread of the organisms isolated. However, given the pressing need to manage the disease on the island, serval recommendations have been put into practice in consultation with the *Phytophthora* action group. These include restricting access to the Peaks area, providing sanitation stations and ceasing seedling production in the Peak's nursery. Restrictions are also being considered regarding the planting out of new areas until the 'health' of nursery-produced plants can be confirmed. The use of chemical treatments would need to be tested experimentally on endemic plants to establish efficacy and then in small subplots to ensure efficacy and no unwanted side effects on endemic flora and fauna. These tests are beyond the scope of the current funding.

Assumption 13 Timely availability of facilities to hold a workshop on St Helena. Stakeholders are keen and available to engage. There have been five stakeholder meetings on the island, and this included both training for growers and extension staff held at various facilities throughout the island. In addition, two presentations explaining the purpose and initial results of the project were hosted at the ENRP facility and by the museum in Jamestown, which was open to all staff on site and the public.

4. Project support to environmental and/or climate outcomes in the UKOTs

The project progress achieved in this reporting year supports the St Helena Government's overarching 10 Year Plan (2017) and Vision and Strategy April 2022-March 2025 and falling from these the national Conservation Areas Management Plan "Restoring St Helena's Internationally Important Cloud Forest for Water Security and Wildlife Implementing the Peaks Management Plan (2021-2026)" and the ENRP Portfolio Strategy and Delivery Plan April 2022 – March 2025 and Climate Change Policy for St Helena (2019). Some of the anticipated benefits on biodiversity, food security and poverty alleviation have been achieved, and significant foundations have been laid towards achieving the remaining benefits:

- The two most problematic plant diseases in vegetable production have been addressed and improved production procedures have led to a more sustainable production. The actions contribute to SHG goal of "Altogether healthier" supporting the increased production of fresh vegetables. Improving the sustainability of agricultural practises contributes to the Climate Change Policy and "All together wealthier" by supporting the security of sustainable food supplies.
- SHG goal "Altogether safer" is working to protect St Helena's borders "Ensuring appropriate Biosecurity legislation and services are in place to protect the community from the increased risk of pests and diseases reaching the Island".
- "SHG's "Altogether greener" Strategic Objective 25 aims to enhance efforts to develop, protect, conserve and promote sustainable use of the island's environment. SO. 27 is directed to mitigate

climate change impact, particularly the impact of drought. Tackling climate change is a key priority the actions this project is contributing to, to support environmental resilience.

- Developing and implementing management plans for Nature Conservation Areas (NCAs) are key to the implementation of the SHG Strategy to encourage their sustainable use. Restoring St Helena's Internationally Important Cloud Forest for Water Security and Wildlife Implementing the Peaks Management Plan (2021-2026) is the first NCA management plan and this project has been directly contributing to action 3.6.1: Identification and assessment of ecology and ecological impact of pathogens associated with all cloud forest trees through (a) Conduct survey and analyse plant-based pathogens; (b) Complete a risk assessment of impact; (c) Identify possible mitigation and management measures and (d) Implement priority recommendations

5. Gender Equality and Social Inclusion (GESI)

During the first 30 months of the project, no specific gender equality issues had to be addressed. However, all activities were in line with the outline provided in the proposal.

Please quantify the proportion of women on the Project Board[1].	40%
Please quantify the proportion of project partners that are led by women, or which have a senior leadership team consisting of at least 50% women[2].	50% (this includes ENRP, SHRI, BiFoR and CABI)

GESI Scale	**Description**	**Put X where you think your project is on the scale**
Sensitive	The GESI context has been considered and project activities take this into account in their design and implementation. The project addresses basic needs and vulnerabilities of women and marginalised groups and the project will not contribute to or create further inequalities.	x

The training provided through the project both in 2022 and 2023 was done in a way to encourage all to attend. Initially, there was a certain amount of apprehension about attending the training on crop diagnosis provided by CABI. This nervousness was overcome by initially performing the training at SHAPE. The participants of the training at SHAPE have learning difficulties but the fact that they were able to do the training emboldened those without formal education to attend at later events. Considerable efforts were made to hold the training at venues and at times that were convenient to all groups i.e. taking into account women with childcare responsibilities and holding evening events to allow farmers to attend. The gender balance for the meetings in 2023 was 38 males and 166 females. The programme engaged with youth through the training given on diagnosis and subsequently on management to the students from the Prince Andrews School.

The training materials for both training in diagnostics and management were adapted to match the experience and abilities of each of the groups as well as the time of each training session. The training

[1] A Project Board has overall authority for the project, is accountable for its success or failure, and supports the senior project manager to successfully deliver the project.

[2] Partners that have formal governance role in the project, and a formal relationship with the project that may involve staff costs and/or budget management responsibilities.

at SHAPE was simplified and was focused on the participants enjoying the training by inclusion at a level they could cope with. Just getting the participants to comment on the photos, and describing what they could see was educational. It was clear residents of SHAPE enjoyed the interaction. The training at Prince Andrew School was modified to make it inspirational, to promote interest in the subject and a desire to learn more and potentially make crop protection career.

ENRP staff are the ones who will benefit most from the training professionally as it is plant protection that is their livelihood. The course was originally intended for these professions and was not significantly modified from its Plantwise origins. Forestry and conservation staff were trained during work time. Many of these workers as also part-time farmers and the course was useful to them in this capacity. The course was adapted where possible to focus on the areas relevant to tree cultivation and management. Farmers do not provide advice to others but were keen to receive the literature on disease prevention and resistance groupings and the use of various chemicals. Likewise, agro input importers were keen to receive similar literature so as to appreciate which chemicals are replacing the older, more toxic, chemicals.

By tailoring content to resonate with participants' backgrounds, skill levels, and objectives, we've fostered a more inclusive and engaging learning environment, promoting active involvement and contribution from all participants. Additionally, we encouraged open dialogue and feedback loops through a course assessment form to further enhance participation and ensure that the project effectively addresses the needs and priorities of all stakeholders.

Ensuring equitable representation and inclusivity has been a priority throughout all training sessions. Where possible we have taken deliberate steps to ensure that both women and men are equally represented, whilst being aware that almost all the forestry staff are male, and acknowledging the importance of gender balance in fostering diverse perspectives and experiences.

6. Monitoring and evaluation

Regular project monitoring has been conducted through meetings and briefings between all project partners via audio/video links, and these meetings have been productive and will continue. The progress towards project outputs has been regularly checked against the ‘Implementation timetable’ during the online meetings and in person during visits to the island in 2023/24. Towards the end of each activity an evaluation with regards to any necessary corrective adjustments is undertaken in consultation with involved stakeholders. In 2023, adjustments to the sequence of activities became necessary to address a delay in pathogenicity testing. This activity was partly replaced by a pathogenicity experiment conducted in the UK quarantine facilities designed to help refine the methodology in preparation for the experiments on the island.

The overall outcome of the project is to have increased the local capacity to manage plant and insect pathogens reducing the risk of biodiversity loss and increasing economic prosperity. Some key project outputs that directly contribute to the project outcome have already been achieved. For example, the project has improved the physical diagnostic infrastructure of the island through the refurbishment and equipping of a new diagnostic facility, and in 2023 this was further strengthened through the addition of a new molecular diagnostic tool made available through matched funding from a Defra grant. Training on the use of the equipment has been provided to partners through workshops and one-to-one training. Bespoke workshops have also been given to stakeholders involved in agriculture and environmental management. Qualitative feedback on the effectiveness of the training has been gathered through questionnaires conducted after the training. New distribution maps developed by SHRI 2023/24 bring together several data streams and provide a visualisation of the distribution of diseased plants within the Peaks as well as the pathogens isolated from them. This information will inform disease management planning in the Peaks. The management plans developed for the identified diseases of salad crops have already provided tangible benefits for the growers. A follow-up visit in 2023 to a hydroponic tomato grower who had received management recommendations from the program revealed a remarkable 35-fold increase in tomato production and the same grower

also reported improvements in lettuce production. Improvements made to the nursery production facilities have improved the production of clean plants. A monitoring process is now in place to test plants before they are planted out and diseased plants are disposed of following a strict protocol. The project reports, being part of the monitoring are generated as collaborative activities, with responsibility shared equally between all project teams. Progress achieved to date has also been reviewed by all team members during the writing of this report.

7. Lessons learnt

Overall, the project team worked extremely well together, despite some technical communication difficulties caused by the extreme geographical distances between individual project partners. However, internet has improved markedly during 2023. It would have been beneficial to have visited the laboratory prior to having made the purchase of equipment to see exactly what the facilities were. Unfortunately, the long shipping times and need to get equipment in place prior to the first visit did not allow for this.

The good and intensive collaboration with research teams from other projects working on similar subjects on St Helena (DPLUS104 'Conserving St Helena's endemic invertebrates through invasive invertebrate control' and the FCDO (CSSF) funded Cloud Forest Project 'Restoring St Helena's Internationally Important Cloud Forest for Wildlife, Water Security') has led to very useful synergistic activities. It is anticipated that all collaborative partner projects will benefit from this synergism and improvements in the individual projects will be seen.

The results from the first two surveys in 2022 made it clear that to comprehensively deal with the tree dieback of all the endemic tree species was well beyond the scope of this project alone. Fortunately, we were able to secure additional match funding from Defra, which has allowed us to work much more intensively on pathogen detection and pathogenicity testing. This has also allowed the instalment of additional capital equipment on St Helena. Additional matched funding is currently sought to continue our research on the same level as last year during the coming months, pushing for the rapid development of mitigating measures as fast as possible.

8. Actions taken in response to previous reviews (if applicable)

There was one actionable comment in the review of the last annual report: *"The revision of the logframe indicators does not appear to have been officially approved through a Change Request – and in any case, requires further work".* "*Logframe indicators should be tightened up (i.e. SMARTened) further and officially approved through a Change Request. Subsequent reporting should focus on achievement of these and the delivery of the project's Outputs and Outcome."*

We have recently updated the indicators according to the recommendations of the last reviewer and Updated indictors have now been submitted for approval in a separate change request to the Darwin Initiative. The updated logframe is attached as annex 2 to this report. The reporting in this document follows the updated indicators.

9. Risk Management

This project started before the risk register was implemented

The most significant risk to the project in 2023 was the delay to the pathogenicity testing on St Helena. A combination of the lack of suitable test plants and delays to the construction of the quarantine shade house meant that this activity was pushed back to early 2024. The production of test plants remains a risk to the project going forward as the test pants are in shorty supply (most are endangered species) and are slow growing. It is hoped that the improved nursery facilities and production protocols will result in more healthy plants for testing purposes. The rapid demise of the trees in conjunction with the discovery of the likely causal agents has led to the urgent need to rapidly upscale monitoring of pathogen spread, confirmation of host species and intensified studying of the ecology of the so far poorly understood pathogens involved. The scale of this turned out to be significantly beyond the

scope of this project and the hence complementary funding was sought from Defra and granted in August 2023.

10. Sustainability and legacy

The profile of the project has been promoted at several levels. Locally, through a public announcement of the arrival of a visiting team of scientists and a radio interview conducted by the minister for Environment, Natural Resources & Planning Portfolio, Christine Scipio at SAMS on 22 January 2024. In this interview the project team described the results that had been achieved so far and what it was planning to cover next. This was followed by an update on project developments through a newspaper article in the local newspaper "The Sentinel" on 1st February 2024 and a public talk at the museum in Jamestown on 28th of February 2024, which was also recorded by the local media and made more widely available via YouTube. In addition, the collaboration with other teams working on biodiversity conservation on St Helena has already led to further planned joint activities. Nationally and internationally the profile of the project has so far been promoted through two blogs providing information on progress and development.

A major aim of this project is to establish sustainable procedures for seedling testing, utilizing the equipment and training provided throughout our project. The production of healthy disease-free seedlings is essential for future restoration work to go ahead. This will be a significant part of the work planned for 2024/25. At this stage our existing strategy (detailed in previous reports is still valid, and no changes are required:

11. Darwin Plus identity

The Darwin logo was represented on slides in a presentation demonstrating the progress made so far during a visit to St Helena on the 28th of February 2024, to which many stakeholders and the public had been invited. The project was featured in a radio interview (SAMS) on St. Helena in January 2024, subsequently resulting in coverage by a local newspaper article. During these events the aim and purpose was explained, and the Darwin Initiative was specifically mentioned as the main funder of the overall project. The project was also presented in a talk given at the UKPD meeting 26th-27th March 2024, RHS Wisley and abstracts for further presentations have been submitted for International Mycological Congress 1-15 August 2024 in Maastricht, Netherlands.

The funder was also acknowledged in two separate blogs (https://blog.cabi.org/2021/09/27/cabi-to-work-in-partnership-to-help-protect-st-helenas-biodiversity-and-enhance-its-agriculture/; https://blog.cabi.org/2022/03/14/project-to-investigate-the-microbial-diseases-of-st-helenas-crop-plants-takes-root/). A recent newspaper article about the project has been drafted.

The project featured in a presentation titled 'Dealing with invasive species on the South Atlantic UKOTs using biological control: an update on recent activities' given at: 'Terrestrial Restoration and Invasive Non-Native Species in the UK Overseas Territories and Crown Dependencies, 6th & 7th March 2023, webinar organised by UK Overseas Territories Conservation Forum'

12. Safeguarding

Has your Safeguarding Policy been updated in the past 12 months?		No
Have any concerns been reported in the past 12 months		No
Does your project have a Safeguarding focal point?	No	
Has the focal point attended any formal training in the last 12 months?	No	
What proportion (and number) of project staff have received formal training on Safeguarding?		Past: unknown Planned: unknown

Has there been any lessons learnt or challenges on Safeguarding in the past 12 months? Please ensure no sensitive data is included within responses. Has there been any lessons learnt or challenges on Safeguarding in the past 12 months? Please ensure no sensitive data is included within responses. No issues regarding safeguarding have been raised or have emerged during the project thus far. All staff involved in the work are part of institutes and organisations, which take safeguarding very seriously and have focal points to allow the safe raising of any concerns (but not specifically dedicated to this project). We are in no doubt that safeguarding is not in any way hindered throughout the involved project partners.
Does the project have any developments or activities planned around Safeguarding in the coming 12 months? If so please specify. Nothing planned at this stage
Please describe any community sensitisation that has taken place over the past 12 months; include topics covered and number of participants.
Have there been any concerns around Health, Safety and Security of your project over the past year? If yes, please outline how this was resolved.

13. Project expenditure

Table 1: Project expenditure <u>during the reporting period</u> (1 April 2023 – 31 March 2024)

Project spend (indicative) in this financial year	**2023/24 D+ Grant (£)**	**2024/25 Total actual D+ Costs (£)**	**Variance %**	**Comments (please explain significant variances)**
Staff costs	[redacted]			
Consultancy costs				
Overhead Costs				
Travel and subsistence				Despite increased travel to St Helena during 2023/24 and specifically during Q1 2024 costs against the Darwin budget were lower than expected due to coverage of a significant amount of T&S through matched funding provided by Defra. See also comment under 'others'
Operating Costs				The high percentage of underspend is simply based on the overall low amount in this position.
Capital items				
Others (Please specify)				Although matched funding from Defra allowed the purchase of additional capital equipment to be installed on St Helena, using this for sample processing required higher expenditure on consumables specifically chemicals used for molecular work. This became only apparent in Q1 of 2024, too late to request an official shift of [redacted] from T&S to this position to push the difference below the 10% threshold.
TOTAL	£86,413	**86,127.1**		

Table 2: Project mobilised or matched funding during the reporting period (1 April 2023 – 31 March 2024)

	Secured to date	Expected by end of project	Sources
Matched funding leveraged by the partners to deliver the project (£)	[redacted]		CABI, ENRP, BioFR
Total additional finance mobilised for new activities occurring outside of the project, building on evidence, best practices and the project (£)			Defra

14. Other comments on progress not covered elsewhere

The project is on track to fulfil its objectives and no change of project design is currently envisaged. However, as already raised in chapter 9 there was an urgent request for complementary funding in 2023 to upscale investigation into the biology of pathogens. The rate of ongoing loss of endemic tree is alarming and unsustainable even over a short period. There is therefore a significant risk of losing not only the tree species themselves but also their associated endemic deadwood invertebrates. A task force has been created to deal with immediate response activities and to coordinate activities with other stakeholders and ongoing projects on the island.

15. OPTIONAL: Outstanding achievements or progress of your project so far (300-400 words maximum). This section may be used for publicity purposes.

I agree for the Biodiversity Challenge Funds to edit and use the following for various promotional purposes (please leave this line in to indicate your agreement to use any material you provide here).

The pathogenicity experiments conducted in 2024 led to the confirmation that *Phytophthora kelmanii* is the causal agent behind the dieback of Whitewood (*Petrobium arboretum*). This is a significant breakthrough as *P. kelmanii* has been suspected to be one of the main causes of the tree dieback in the St Helenian cloud forest. Positively identifying the cause of the decline of the whitewood is a big step towards formulating a managment plan for this rare endangered species

File Type (Image / Video / Graphic)	**File Name or File Location**	**Caption including description, country and credit**	**Social media accounts and websites to be tagged (leave blank if none)**	**Consent of subjects received (delete as necessary)**
Video	https://youtu.be/z_b-gxrg17Q	A Study of Tree Disease on St Helena - Amy Webster & Jayne Crozier		Yes / No
Audio-Radio interview	https://open.spotify.com/episode/7j52F8x3iOfAJ4PNghHrXx?si=b41275e1e4c948d1&nd=1&dlsi=9c23eb1c30c34c97	In Scope: Environment and Natural Resources and planning – Focus on update on Peaks National Park		Yes

Annex 1: Report of progress and achievements against logframe for Financial Year 2023-2024

Project summary	Progress and Achievements April 2023 - March 2024	Actions required/planned for next period
Impact Biodiversity on St Helena will not be threatened with loss due to invasive non-native plant pathogens and livelihoods based on production and use of the Island's natural resources with be improved.	We have broadly achieved what we set out to do during the first three years (which was in effect only 2.5 years). The production of essential salad vegetables has considerably increased by the end of 2023 due to new management procedures put in place in 2022. The capacity of a wide range of stakeholders to independently diagnose plant pests and diseases and effectively manage them was brought about through a series of training events. Capacity for the identification of pathogens has increased due to laboratory training and the installation of new diagnostic equipment as initially envisaged. There is still a significant amount of work to be covered during the last year with regards to the assessment and management of endemic trees. However, we anticipate that all deliverables will be completed as planned.	[redacted]
Outcome St Helena will have an increased local capacity to manage plant and insect pathogens reducing the risk of biodiversity loss and increasing economic prosperity		
Outcome indicator 0.1 Changes to habitat management practices in the cloud forest, and afforestation areas based on best practice recommendations. Healthier nursery stock in production by end of project (please note: a slowed or reversed dieback due to the measures put in place will only become apparent within 10 years after termination of the project).	Confirmation of *Phytophthora kelmanii* as the causal agent responsible for the dieback of Whitewoods in 2023, leading to development of the first draft management plan for habitat management in the cloud forest (annex 4.5). Results from the research conducted during the first three years of this project informed the development of a new protocol to produce healthy nursery stock at the ENRP facilities in Scotland, St Helena by the Cloud Forest Project team. Evidence for this was the availability of disease-free tree seedling becoming available for 2 pathogenicity trials in early 2024.	• Additional pathogenicity testing to be carried out on additional endemic tree species • Survey presence of *P. kelmanii* in soil using molecular detection. • Spot checks in the nursery for presence of *P. kelmanii* using the LAMP system.

Outcome indicator 0.2 Reduction in reported crop failures due to disease (currently the failures of at least 5 crops can mostly be attributed to pathogens or unknown causes that might be pathogens. More crops are not reaching full maturity due to disease)	Training of growers and extension staff continued with a module on disease management following the diagnostic training in 2022. After addressing the problems of plant diseases in indoor vegetable production, at the largest production site on St Helena, production has significantly improved as evidenced through photos in annex 4.4. No crop failures for tomato and lettuce have been reported since. Training of staff ENRP and SHRI in laboratory and plant pathology techniques will continue.	Key actions for 2023/24 will be: • No further surveys for crop diseases are planned but the team will be open to follow up any new reports on crop failures due to plant pathogens. • Assessment of newly reported symptoms on wattle trees within the forestry sector
Outcome indicator 0.3 Increased lab diagnosed diseases from current level, 3, to 15 by the end of the project	The project team on St Helena, (staff from ENRP and SHRI), have already independently isolated numerous fungi from diseased plants, primarily from endemic trees, and sent 4 batches of isolates for further identification to CABI. These skills were complemented through further training during 2023/24 in the use of the LAMP system for the identification of tree pathogens.	• Further training in extraction of DNA and the use of the newly installed LAMP system
Output 1 Pathogens at the heart of existing and emerging threats identified for the agricultural, forestry and environmental sectors.)		
Output indicator 1.1 At least 50 searchable records of pathogens and their hosts recorded in St Helena accessible in newly developed Excel database, by end of Y1 (The Y1 records create a baseline against which to assess new pathogen records. The database brings together, historical information on plant/insect pathogens as well as those newly identified through surveys undertaken during the project. Currently the small amount of published information on the presence of plant pathogens on St Helena is highly dispersed and not accessible in one place or searchable for specific taxa)	This output was achieved between the start of the project and the end of the first financial year. Surprisingly little data is available through public information resources regarding existing records of plant pathogens on St Helena (40 records) and almost nothing regarding pathways and impact. Some records were found through the digitised data from the old 'International Mycological Institute' (IMI) and a full text assessment of the literature in the CABI 'Crop Protection Compendium' (CPC). These few records are nevertheless important and are included in the first version of the of the project database now established and attached as annex 4.1 of this report. During the first visit to St Helena the library of ENRP and plantation house (seat of the governor) were searched for useful information. However, there was little information, and what was available was not sufficiently technical to be of use.	• Although this output has been achieved the database remains open to include any additional information the team will discover during the remainder of the project.

Output indicator 1.2 Number of records held in database increased year on year exceeding 300, by Y4 Q3 (The database will be regularly updated with findings from the surveys undertaken on St Helena. It anticipated that several revisions will be made to the database)	This output has been almost accomplished by the end of year 3. The latest version of the database including the results from the literature research and records collected during the first 5 visits is attached as annex 4.1 to this report. The design of the database is still considered to be a draft and the final design may change as more samples are added. As the last visit took place close to the end of the third project year, some samples collected during the visit are not yet processed and entered. The database will remain open throughout the life of the project for further records to be included. It is important to mention that at least two new plant pathogens have been discovered, which are closely associated with endemic plants on St Helena. One is a *Ramulariopsis* species on Jellico and the second a new undescribed rust fungus on Whitewood (see annex 4.2).	• Where appropriate additional records will be added to the database through the next project year.
Output 2. Current and future impact of pathogens on the peaks cloud forest species and economically important crops assessed.		
Output indicator 2.1. At least 1 plant pathogenic taxon each affecting endemic tree species and agricultural crops identified by Y3, Q3, which had not been recorded or managed before the start of the project (by the final year it will be known whether plant pathogens are the main causal agent, or at least contributing factors, to the tree dieback) Currently, the causes of the dieback of trees on St Helena are unknown)	A *Phytophthora* species belonging to clade 8a was isolated from dying whitewood, dogwood, redwood and She cabbage early in the project. This pathogen has now been identified as *P. kelmanii*. Several other pathogenic genera have been identified from dying plants and may be implicated in the decline. These include *Fusarium, Ilyonectria*, and *Pythium.* All of these putative pathogens still required pathogenicity testing at the start of year 3 to establish, which of them are the causal agents behind the dieback. Due to the recognition that the endemic trees are difficult to propagate and that it takes longer to produce specimens of a sufficient size to conduct pathogenicity experiments the necessary experiments could only start in early 2024. However, we have, made significant progress towards output 2, by confirming *P. kelmanii* as the causal agent for Whitewood,	• Assessment of samples and identification of likely causal agents of the tree dieback will continue in year 4. This will be supplemented through additional site visits later in 2024. A major part of the work outlined for 24/25 is conducting pathogenicity experiments on disease-free seedlings to establish which pathogens are responsible for tree death and dieback.

	Pythium and Pseudomonas were identified pathogens behind the yield losses in tomato and lettuce production respectively. We have also recorded a new pathogen associated with Cape yew, which is an important forestry species on St Helena.	
Output indicator 2.2 Impact of the two most threatening pathogens quantified using a combination of disease severity and potential dispersal pathways by Y4Q4	Work has started on assessing the impact on cloud forest species and economically important crops, including identification and prioritization of threats has been developed	• Work on an assessment report has already started and will continue throughout 2024/25.
Output indicator 2.3 All pathogenic taxa recorded during the project in association with economically important crops and endemic tree species profiled regarding their potential future impact by Y4Q3 (This will include, for the first time, identification of pathogens to species level (so far only generic diagnosis such as 'blight' etc. appear in island literature)	Samples have been taken by CABI pathologists and the BiFoR team from all endemic tree species showing signs of infection by pathogens. This includes soil samples taken from the vicinity of diseased trees. Initial isolation of pathogens from leaf, branch and trunk tissue was undertaken at the newly refurbished ENRP lab at Scotland on St Helena. Plates containing these samples, plus frozen leaf and soil samples, were transported to the CABI facilities at Egham UK where further processing continues. At the time of writing isolation of plated pathogens from the first four visits has been finalised, but molecular identification is still ongoing. Preliminary results are provided in annex 4.1	• Molecular and morphological identification of St Helenian pathogens will continue and an assessment regarding potential threats will continue in the coming year
Output indicator 2.4 All entomopathogenic fungi (EPF) recorded during the project profiled regarding threats and benefits for endemic invertebrates present on St Helena by Y4Q3 (For the first time EPF will be identified to species level)	After finalising both surveys for EPF identification and then assessing the threat of the discovered pathogens to endemic invertebrates' results are presented in annex 4.3	• Some final molecular identifications necessary for the description of newly discovered species are still outstanding and this will be covered in the coming year.
Output 3. Action plan to mitigate priority identified threats developed with and made available to all stakeholders		
Output indicator 3.1	The repeated isolation of a soilborne *Phytophthora* (*P. kelmanii)* from dying endemic plants made this pathogen a strong candidate for the tree dieback observed on St Helena	• Assessment of spread of plant pathogens in the peak national park will continue

Adoption of improved management practices for at least 4 priority threats to cloud forest species and/or economically important crops. by Y4Q2	and this pathogen has now been confirmed as a causal agent behind the dieback of Whitewoods. However, prior to this discovery and due to the perceived threat based on experience of similar *Phytophthora* species elsewhere in the world, a task force was initiated. The taskforce includes a wide range of stakeholders and meets on a regular basis. Recommendations from the taskforce include a range of phytosanitary measures including significant restrictions to access of either already infected or very sensitive sites. In addition, new protocols for the disease-free production of tree seedlings have been introduced by the cloud forest project team based on results from this project during 2023.	and we will shift a focus onto the assessment of soil and rhizosphere samples using new methodological approaches. This will inform an updated management/action plan • Work on the action plan will continue in year 4. The action plan is contingent on the identifications of the pathogens collected during the now altogether five site surveys and the results from pathogenicity experiments.
Output 4 Capacity for St Helena to address threats caused by pathogens independently increased.		
Output indicator 4.1 At least 30 stakeholders (disaggregated by gender, age, etc.) proficient in the diagnosis of diseases and best practice for effective control by Y3Q4	Training of stakeholder in diagnostics and disease management has been finalised in 2023 through altogether five workshops held on St Helena in October 2023 targeting extension, research staff and commercial and other growers (see annex 4.4). This round of training has been mainly focused on disease management and was well received by attendees. Training material based on CABI's Plantwise program had been developed prior to the conduct of workshops.	• No further activities planned for 2024/25
Output indicator 4.2 At least 6 staff trained in the use of diagnostic facilities enabling them to independently isolate and diagnose plant diseases by Y4Q1	A major step towards this output has been achieved through the refurbishment of the pathology lab at ENRP (St Helena; Scotland site) with a comprehensive set of equipment necessary for isolation and morphological identification of pathogens. This has been widened in 2023/24 through the instalment of new equipment, allowing staff on St Helena independently to detect specific s pathogens through DNA extractions from samples taken from diseased plants (see photos further above in this report). Training in the use of the	• Further training on the use of new equipment during the next team visits in 2024/25.

	new equipment has been provided to 5 staff from ENRP and SHRI in the last year alone.	
Output indicator 4.3 4.3 At least 300 records and information about known pathogens of St Helena available online by Y4Q4	Jointly collected samples of diseased plants were used to provide on the job training towards building capacity to independently process samples in the future. Training included the use of a laminar flow cabinet, autoclave, agar preparation, and the isolation of pathogens from plant samples. On the job training took up considerable time,but was essential to jointly kickstart the pathogen surveys. This was supported by training in diagnostics during the visits in 2023/24. The team on St Helena has now independently recorded a high volume of samples and SHRI has started to put together a database linking pathogen records to individual trees within the Peaks National Park. We are well on track to cover this output indicator by the end of the project.	• Finalising database on disease records and making data accessible online
Output 5 Pathogen treatments implemented.		
Output indicator 5.1 At least one new treatment measure developed and tested during Y3Q2 to Y4Q2	Pathogen management has been successfully implemented in the horticultural sector (annex 4.5). Due to the undetermined cause of the problems on several of the endemic trees it is not possible to provide any comprehensive treatments at this stage. However, advice was provided on the growth conditions of the seedlings in the nursery, which has led to an updated protocol aiming to produce disease free seedlings.	• In line with the development of a final version of a action plan for the management of tree diseases on St Helena recommendation will be specifically developed to cover the main threat on the island caused by *P. kelmanii* in the coming year.
Output indicator 5.2 At least one new treatment practice(s) demonstrates a quantifiable reduction in the spread and/or severity of disease, by Y4Q3	This has become difficult to survey in a scientifically sound way as no baseline data on yield have been previously recorded and growers are not able to provide exact measures of current yield levels. However, the report provided in annex 4.5 clearly demonstrates a significant recovery from high yield losses after the introduction of adequate phytosanitary treatments.	• We will continue to provide advice to growers how to assess efficacy of newly implemented plant disease management measures.

Annex 2: Project's full current logframe as presented in the application form (unless changes have been agreed)

Project summary	SMART Indicators	Means of verification	Important Assumptions
Impact: (Max 30 words) Biodiversity on St Helena will not be threatened with loss due to invasive non-native plant pathogens and livelihoods based on production and use of the Island's natural resources with be improved.			
Outcome: St Helena will have an increased local capacity to manage plant and insect pathogens reducing the risk of biodiversity loss and increasing economic prosperity. (Max 30 words)	1.1 Changes to habitat management practices in cloud forest, and afforestation's based on best practice recommendations. Healthier nursery stock in production by end of project (please note: a slowed or reversed dieback due to the measures put in place will only become apparent within 10 years after termination of the project). 1.2 Reduction in reported crop failures due to disease (currently the failures of at least 5 crops can mostly be attributed to pathogens or unknown causes that might be pathogens. More crops are not reaching full maturity due to disease). 1.3 Increased lab diagnosed diseases from current level, 3, to 15 by the end of the project.	1.1 Existing management plan updated to address dieback with new best practice guidelines; assessment report as annex to final project report comparing pathogen levels at start and end of project within nurseries (please note: a slow down or decrease of dieback resulting in higher survival rates of nursery stock can only be recorded by national park and forestry management in years after the termination of the project). 1.2 Survey results on yield improvement compared to levels at the start of the project conducted in Y3Q4 to Y4Q3 and provided as final report annex. (please note: yield improvement will also lead to decrease in expensive imports of horticultural produce. However, this is likely only to become apparent within 5 years after the termination of the project). 1.3 Lab protocols /records and publication of new disease records by the end of the project.	Sufficient baseline data already available to allow comparison Mitigation: In case of lack of baseline data, gathering of data at the start of the project. There are no outbreaks of Covid on St Helena that will cause significant disruption/delay to project delivery and there are no new variants in the UK that will result in a change to the current quarantine restrictions. Mitigation: The timing of travel will remain as flexible as possible so as to accommodate any changes in the Covid status of the countries. Training could be provided remotely so as to avoid quarantine restrictions if circumstances demand. Identified stakeholders, including women, are available to participate in project activities. Mitigation: Ensure training dates are flexible to accommodate the other commitments of stakeholders. All partners and their staff deliver timely on their commitments to the project.

Project summary	SMART Indicators	Means of verification	Important Assumptions
			Mitigation: Regular steering group meetings and Project Governance according to Prince 2 methodology. Applied research approved by St Helena Research Council. Mitigation: Project has been designed and developed with local authorities and reflects locally identified needs and priorities.
Outputs: **1.** Pathogens at the heart of existing and emerging threats identified for the agricultural, forestry and environmental sectors.		1.1 An Excel database of all recorded plant pathogens and associated vectors and entomopathogenic fungi of St Helena by end Y1. Draft database produced by end of Y1 and available as annex to first annual project report. 1.2 Updated database containing all newly identified plant pathogens, vectors and entomopathogenic fungi by Y4Q3. Database revised and updated and contains more records than recorded at the end of Y1 by Y4Q3 and available as annex to final project report.	Archived data is freely accessible. Mitigation: Pay for literature not freely accessible from consumable budget.
	1.1 At least 50 searchable records of pathogens and their hosts recorded in St Helena accessible in newly developed Excel database, by end of Y1. (The Y1 records create a baseline against which to assess new pathogen records. The database brings together, historical information on plant/insect pathogens as well as those newly identified through surveys undertaken during the project. Currently the small amount of published information on the presence of plant pathogens on St Helena is highly dispersed and not		Export licenses for pathogen samples in place to allow identification at CABI & UoB facilities in the UK. Mitigation: Focus at the start of the project on getting licenses approved in time. Access to the infected parts of the infected trees is easily possible. Mitigation: Use telescopic tools to reach high branches. Local farmers willing and keen to engage and share their local knowledge. Mitigation: Share

Project summary	SMART Indicators	Means of verification	Important Assumptions
	accessible in one place or searchable for specific taxa). 1.2 Number of records held in database increased year on year exceeding 300, by Y4 Q3. (The database will be regularly updated with findings from the surveys undertaken on St Helena. It anticipated that several revisions will be made to the database)		information about the project and potential benefits to them. Providing access to the resources produced as a result of the project. Timing of travel to and from St Helena not disrupted by COVID 19 or adverse weather conditions. Mitigation: Having within each financial year as much flexibility as practical in timing of activities so that the project can accommodate flight delays and quarantine requirements.
2. Current and future impact of pathogens on the peaks cloud forest species and economically important crops assessed.	2.1 At least 1 plant pathogenic taxon each affecting endemic tree species and agricultural crops identified by Y3, Q3, which had not been recorded or managed before the start of the project. (by the final year it will be known whether plant pathogens are the main causal agent, or at least contributing factors, to the tree dieback. Currently, the causes of the dieback of trees on St Helena are unknown). 2.2 Impact of the two most threatening pathogens quantified using a combination of disease severity and potential dispersal pathways by Y4Q4. 2.3 All pathogenic taxa recorded during the project in association with economically important crops and endemic tree species profiled regarding their potential future impact by Y4Q3. (This will include, for the first time, identification of pathogens to species level (so far only generic diagnosis such	2.1 & 2.2 Preliminary observations and findings described in Y1,Y2 and Y3 survey reports and available in annual reports. First journal publication in case of discovery of a new disease by end of project. 2.1 & 2.2 Draft assessment/impact reports on cloud forest species and economically important crops, including identification and prioritization of threats available by Y4Q4. 2.3 & 2.4 Preliminary findings and observations described in Y1, Y2 and Y3 field survey reports and included as an annex in the final project report.	Standard diagnostic procedures allow to measure current spread of pathogens Mitigation: Drawing in external specialist advice in case unusual methods have to be employed. Travel to and from St Helena not disrupted by COVID 19 or adverse weather conditions Mitigation: Having as much flexibility as practical in timing of activities so that if flights delayed or quarantine required it can be accommodated within the FY.

Project summary	SMART Indicators	Means of verification	Important Assumptions
	as 'blight' etc. appear in island literature) 2.4 All entomopathogenic fungi (EPF) recorded during the project profiled regarding threats and benefits for endemic invertebrates present on St Helena by Y4Q3. (For the first time EPF will be identified to species level)).		
3. Action plan to mitigate priority identified threats developed with and made available to all stakeholders.	3.1 Adoption of improved management practices for at least 4 priority threats to cloud forest species and/or economically important crops. by Y4Q2.	3.1 Action plans published and disseminated to stakeholders by Y4Q2. Plans included as annexes to the final project report.	Treatments and best practice procedures are available or can be developed based on existing knowledge of the pathogens newly identified and recorded for St Helena. Mitigation: Drawing in specialist external advice in case unusual methods have to be employed.
4. Capacity for St Helena to address threats caused by pathogens independently increased.	4.1 At least 30 stakeholders (disaggregated by gender, age, etc.) proficient in the diagnosis of diseases and best practice for effective control by Y3Q4	4.1 Training Material; PPT presentations; list of workshop attendees, attendee feedback reports.	Timely availability of facilities to hold workshop on St Helena. Stakeholders are keen and available to engage Mitigation: Book early, early engagement, advertisement & timely invitations and venue

Project summary	SMART Indicators	Means of verification	Important Assumptions
	4.2 Number of new pieces of Laboratory equipment and consumables added to the ENRP research laboratory by Y2Q4. 4.3 At least 6 staff trained in the use of diagnostic facilities and able to independently isolate and diagnose plant diseases by Y4Q1.	4.2 Before and after photos of improved facilities; press releases; first recorded diagnosis in new lab and the publication of new disease reports from St Helena (available as annex in second annual project report). 4.3. Test protocols available. Plantwise test results show an increase of knowledge in trainees by an increase in the score between the two tests. 4.4 DOI to pathogens of St Helena published and shared by the end of the project.	/workshops timed to suit stakeholders. Travel to and from St Helena not disrupted by COVID 19 or adverse weather conditions Mitigation: Shift to virtual online training workshop.
5. Pathogen treatments implemented.	5.1 At least one new treatment measure developed and tested during Y3Q2 to Y4Q2. 5.2 At least one new treatment practice(s) demonstrates a quantifiable reduction in the spread and/or severity of disease, by Y4Q3.	5.1. Protocols of rollout added to final project report. 5.2. Report of results of survey in crops and nursery stock included as annex to final project report.	Internet connection will allow remote organisation and supervision of activities including the use of shared remote microscopy Mitigation: Use consumable budget for extensive telephone communication. Farmers amenable to implement changed farming practices. In case of pesticide requirement availability of products is guaranteed Mitigation: Starting public engagement with farmers at an early stage; explore the potential to use alternative products.

Activities (each activity is numbered according to the output that it will contribute towards, for example 1.1, 1.2 and 1.3 are contributing to Output 1)

0.1 First audio/video conference with all project partners present; project introduction; discussion of work plan and amendments if necessary; establishment of communication channels/procedures/frequency of video calls.

1.1 Collation of existing information on pathogens previously recorded on St Helena, presumed pathways of introduction and any observed or recorded impact. Preliminary listing of priority needs and gaps. Literature review conducted supported through on island research of hard copy reports and papers.

1.2 Cataloguing of pathogens and associated vectors including the ones recorded during the project. This activity will be based on excel and is an ongoing process. The catalogue will remain open for further additions after Y2 Q4 and beyond the termination of the project.

2.1.1 Assessment of tree dieback of cloud forest trees including survey for causal agents during first survey visit in Q3 Y1 by CABI team and PhD student; species finalised by Y3 Q3

2.1.2 Second on site survey for tree pathogens by CABI PhD student

2.1.3 Processing of samples and development of assessment report

2.2.1 First onsite survey of crop and forestry pathogens as well as EPFs including farmer interviews

2.2.2 Second onsite survey of crop and forestry pathogens as well as EPFs

2.2.3 Processing of samples and development of assessment report

3.1 Action plan to mitigate identified threats in all assessed sectors developed jointly with and made available to all stakeholders

4.1.1 Development of training material based on action plan

4.1.2 Three workshops held on St Helena to train relevant stakeholders in diagnosis of diseases and best practice for efficient control.

4.1.3 Student and community engagement through trial plot at Prince Andrews School; ongoing supervision onsite by SHRI and ENRP

4.2 Improvement of laboratory facilities for diagnostic of pathogens and/or preparation of samples for shipment for external identification. Final review of material and equipment list in Q3 Y1 after joined site inspection; order of new equipment in Q3 Y1; shipment and instalment until Q4 Y2

4.3 First onsite training of at least 6 staff in using improved diagnostic facilities & CABI online tools; established Plantwise test applied before and after training to measure the increase in knowledge by an increase in the score on the two tests in Q1 Y2; further onsite supervision of trained staff during follow on CABI team visits Q3 Y2, Q1 Y3 and Q1 Y4

5.1 Implementation of treatment measures starting during Y3 Q2

5.3 Efficacy of treatment surveyed in crops and with nursery stocks in Y4 Q3

Annex 3: Standard Indicators

Table 1 Project Standard Indicators

DPLUS Indicator number	Name of indicator	Units	Year 2 Disaggregation Total	Year 3 Disaggregation Total	Total to date	Total planned during the project
4.3	Number of farmers trained in pest management	People		4 male	4	
4.3	Number of extension staff and growers who attended training at Scotland (room in laboratory complex)	People	7male 6 female	2 male 8 female	13+10	at least 6
4.1	Number of forestry and conservation workers and officers who attended training at the Kingshurst community centre	People	20 male 5 female	Did not take place at Kingshurst	25	at least 30
4.1	Number of forestry and conservation workers and officers who attended training at the Scotland nursery training room	People		16 male 1 female	17	
4.1	Number of growers who attended training at Shape, Sandy Bay	People	6	6 male; 3 female	9+9	
4.1	Number of pupils who attended training at Prince Andrews School	People	8	10 male 4 female	8+14	

Table 2 Publications

Title	Type (e.g. journals, best practice manual, blog post, online videos, podcasts, CDs)	Detail (authors, year)	Gender of Lead Author	Nationality of Lead Author	Publishers (name, city)	Available from (e.g. weblink or publisher if not available online)
A Study of Tree Disease on St Helena	You tube video					https://youtu.be/z_b-gxrg17Q
In Scope: Environment and Natural Resources and planning – Focus on update on Peaks National Park	Radio interview					https://open.spotify.com/episode/7j52F8x3iOfAJ4PNghHrXx?si=b41275e1e4c948d1&nd=1&dlsi=9c23eb1c30c34c97
In Scope: Environmental. Natural Resources & planning Portfolio - Focus on update on Peaks National Park	Newspaper article	Anita Robbertse, SANS	female	British	SAMS, St Helena	Sentinel, St Helena

Annex 4: Onwards – supplementary material (optional but encouraged as evidence of project achievement)

Annex 4.1 List of project meeting held in 2023/24

Annex 4.2 Newly discovered pathogens from endemic plants

Annex 4.3 Report on EPF surveys

Annex 4.4 Tomato and lettuce management plan

Annex 4.5 Draft tree diseases management plan

Annex 4.6 Tree disease maps

Annex 4.7 Risk register

Checklist for submission

	Check
Different reporting templates have different questions, and it is important you use the correct one. Have you checked you have used the **correct template** (checking fund, type of report (i.e. Annual or Final), and year) and **deleted the blue guidance text** before submission?	X
Is the report less than 10MB? If so, please email to BCF-Reports@niras.com putting the project number in the Subject line.	X
Is your report more than 10MB? If so, please discuss with BCF-Reports@niras.com about the best way to deliver the report, putting the project number in the Subject line.	X
Have you included means of verification? You should not submit every project document, but the main outputs and a selection of the others would strengthen the report.	X
If you are submitting photos for publicity purposes, do these meet the outlined requirements (see section 15)?	X
Have you involved your partners in preparation of the report and named the main contributors	X
Have you completed the Project Expenditure table fully?	X
Do not include claim forms or other communications with this report.	