Darwin Plus:
Overseas Territories Environment and Climate Fund
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 2023

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Darwin Plus Project Information

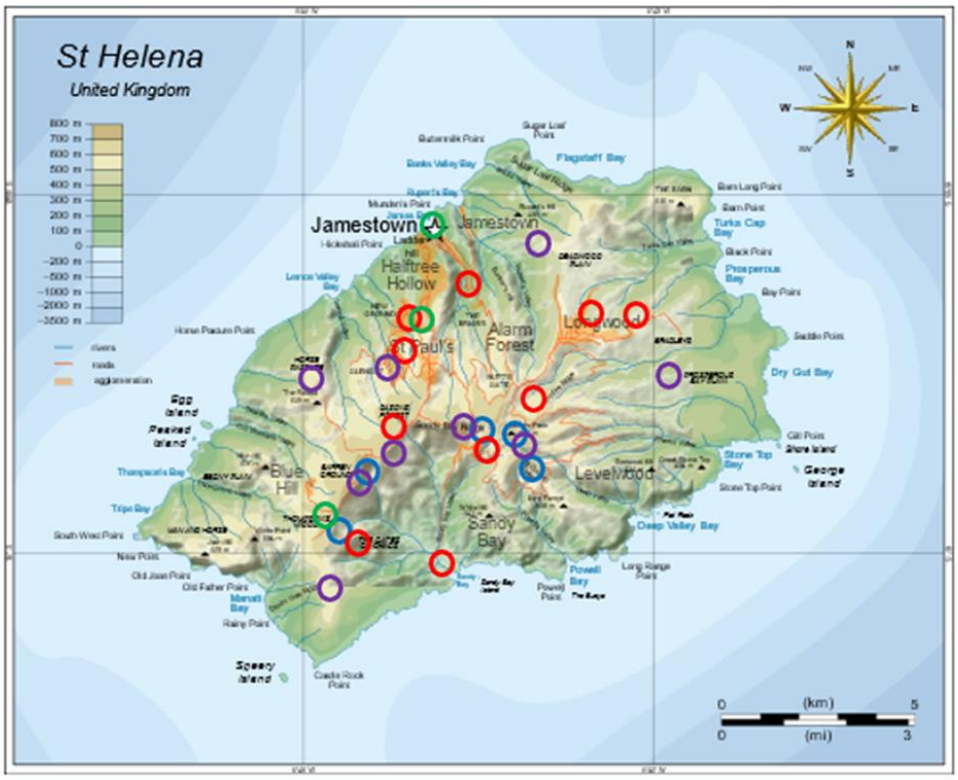
Project reference	DPLUS157
Project title	Managing the pathogens threatening St Helena's biodiversity and food security
Territory(ies)	St Helena
Lead Partner	CABI
Project partner(s)	St Helena Research Institute (SHRI), Environment, Natural Resources and Planning Directorate (ENRP)
Darwin Plus grant value	£ 265,440
Start/end dates of project	16/09/2021- 31/03/2025
Reporting period (e.g. Apr 2022-Mar 2023) and number (e.g. Annual Report 1, 2)	September 2022 – March 2023; Annual report 2
Project Leader name	Rob Reeder
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 Reeder, Norbert Maczey, Phil Taylor, Jayne Crozier, Amy Webster with contributions from SHRI and ENRD; 30 April 2023

1. Project summary

St Helena's endemic trees and 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 will 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.



Map of St Helena showing the field sites visited by the project team in February/March and October/November 2022.

2. Project stakeholders/partners

The main project partners are CABI, ENRD, 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. The project team has been designed to provide regular oversight of the project, review progress, consider problems and develop solutions, monitor and evaluate project outputs and outcomes. Each partner can report back at any time to the team.

During October 2021, most of the capital equipment and consumables for the ENRD laboratory were purchased. The equipment arrived in St Helena before the first team visit ready to be installed in the new laboratory. Training was given in to St Helena staff in the use and maintenance of the equipment.

Based on the initial training and use of the lab, additional equipment and consumables were identified for purchase and a budget was allocated for this in year 2 of the project. The additional equipment and consumables were ordered at the start of last financial year and shipped to arrive during the second visit in October 2022.

In contrast to early 2022, when face-to-face collaboration on St Helena was restricted due to a mandatory 10-day quarantine period, work during the second visit proceeded smoothly with members of the CABI team visiting over a five-week period. As with the previous visit, the St Helena team planned the project team's visit meticulously, with logistics arranged by SHRI. All

project partners participated in a range of field surveys, including SHRI and the plant protection, forestry, and biosecurity sections of ENRD.

Stakeholders:

Some of the key stakeholders are organisations involved with biodiversity conservation on St Helena. Complementary projects are 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'" with the St Helena National Trust, RSPB and SHRI being main project partners. Collaboration between these projects began during the first visit and was further intensified during the second year of the project. As soon as it became clear that urgent phytosanitary measures needed to be implemented, a task force was established. The taskforce, currently chaired by the RSPB, meets fortnightly, with all major stakeholders taking part. During 2022 the team collaborated with the Great Britain Non-native Species Secretariat (GBNNSS) providing training for biosecurity staff on pest risk assessments (PRA), a work package complementary to some of the activities in our project.

Major stakeholders are also 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 second team visit in October to identify the main disease issues from the growers' perspective.

The project remains open to sharing the outcomes throughout the project as widely as possible and encouraged all stakeholders to take an active part in project planning and decision making.

3. Project progress

3.1 Progress in carrying out project activities

Activities during the project year 2022/23 followed the ones outlined in the project log frame but also took into consideration the findings from the first year. One issue that was identified was that the seedlings of the endemic trees required for the pathogenicity testing of potential disease-causing organisms are difficult to grow due to low germination rates and slow growth. Therefore, the activities linked to the pathogenicity experiments, initially planned for 22/23, have now been moved into project year 23/24 to allow for time to propagate the seedlings in sufficient numbers for testing. This also impacted on the timing for the second visit of the PhD student Amy Webster, who is now scheduled to visit in the last quarter of 2023.

The timing of the first visit in February 2022 was considered sub optimal for the pathogen survey. As a result, the first entomopathogenic fungus (EPF) survey was postponed until the latter half of 2022 and the second survey shifted into 23/24. These changes were communicated to DI and the change request approved. All other activities went ahead as planned with the majority taking place between mid-October and end of November 2022 during the second visit to St Helena by the CABI team.

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

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.

The number of organisms identified from St Helena continues to grow. Currently there are 282 records in the data base. 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.

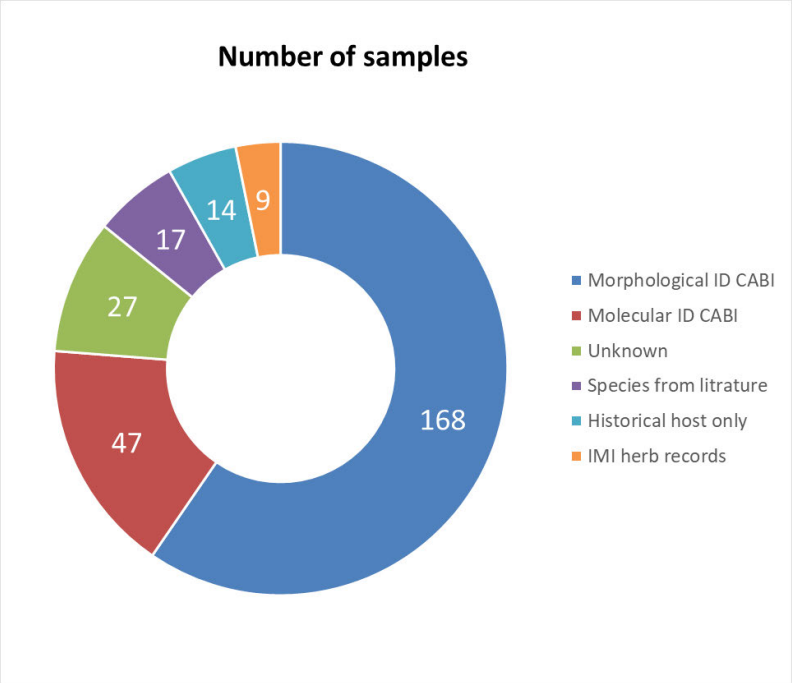


Figure1: Breakdown of plant and insect pathogens recorded from St Helena

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

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

During the second visit in October/November 2022, the CABI/St Helena team re-visited the cloud forest to conduct a second survey of the endemic trees to reassess trees already showing signs of decline from the first survey and look for evidence of trees with new symptoms of disease. As *Phytophthora* species had been isolated and identified from the previous survey the team came equipped with *Phytophthora* rapid diagnostic kits. These kits can be used in the field to give an almost instant indication for the presence of *Phytophthora* (or other closely related oomycetes).

Tissue from the affected parts of the tree (usually the lower stem or roots) was placed in a bottle containing a buffer and shaken, a few drops of the resulting liquid was placed in the lateral flow device and two lines indicated a positive result for *Phytophthora*. Where trees were showing signs of dieback or visible cankers on the stems the bark was removed to look for dark staining on the stem usually close to the soil level or below on the roots. Samples of stem/root tissue were collected with a knife. Samples of tissue were tested for *Phytophthora* using the kits and placed on *Phytophthora* selective media in the field; additional samples of tissue were also taken back to the lab for further testing.

At 'The Peaks' several trees had died since the first survey and other trees were showing new or advanced symptoms of dieback (Whitewood, Black Cabbage, He Cabbage, She Cabbage and Dogwood). This became particularly apparent from a monthly monitoring of selected Black cabbage trees, which was instigated after the first visit (disease progress documented in annex 4.5). Samples were also taken from the leaves of He Cabbage trees at 'Taylors' where half of the tree canopy had been lost through dieback and from Black Cabbage seedlings from 'The Peaks' nursery suffering from leaf spots and some necrosis of the roots.

Other signs of dieback were observed at 'George Benjamin's Arboretum' where a She Cabbage and Whitewood tested positive for *Phytophthora* using the kits. At 'Peak Dale' two of the large Gumwoods showed signs of decline, further monitoring reported that these trees have since died and further investigation is necessary. Several trees around the nursery site at Scotland were also showing signs of dieback, on further examination two Gumwoods and a Dogwood tested positive for *Phytophthora* using the kits. However, the seemingly affected endemic Rosemary (*Phylica*) only showed a weak positive and results were inconclusive. Disease symptoms were also recorded on Bastard Gumwood at 'Heart-shaped Waterfall' and Gumwood at 'Peak Dale' but further investigation is required.

Molecular identification of the isolated pathogens is continuing at CABI UK. To date several potential pathogens have been identified (*Phytophthora, Pythium, Fusarium, Ilyonectria, Erwinia*) but work is continuing. To confirm pathogenicity, Koch postulates must be fulfilled, which involves inoculating healthy plants with isolates and subsequently recovering them from diseased plants. However, at the present time seedlings and facilities are unavailable in St Helena – this step is needed urgently, and efforts are being focused to complete this activity.

Figure 2: Dying He cabbage (*Pladaroxylon leucodendron*) at 'Taylor's'

Figure 3: Sample collected from dying He cabbage (*Pladaroxylon leucodendron*) at 'Taylor's'

Figure 4: Black cabbage (*Melanodendron integrifolium*) seedlings at 'Peaks Nursery'

Figure 5: Leaf spot on Black cabbage (*Melanodendron integrifolium*) seedling at 'Peaks Nursery'

Figure 6: Diseased *Commidendrum rotundifolium* (Bastard Gumwood) at Heart-shaped Waterfall

Figure 7: Diseased Whitewood (*Petrobium arboretum*) on Cabbage tree road

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

Jayne Crozier and Phil Taylor surveyed several areas of crop production during the second visit to St Helena. As was found in the first visit there was a remarkable absence of common plant pathogens on the crops of St Helena. Sites at 'Maldivia' in Jamestown and 'Horse Ridge' were visited along with 'SHAPE' at Sandy Bay and the polytunnel production site at 'Harpers'.

The CABI team were specifically asked to visit the polytunnels at ‘Harpers’ due to disease concerns. Martin Joshua is the grower specialising in the hydroponic production of tomatoes and lettuce. The plants lacked turgor and were severely stunted with no yield and extremely poor root development. In conversation with the grower, it was clear that some root pathogen was the issue partially due to the appearance of the roots but also as the system sterilizing the flowing nutrient solution had only been installed three days previously and the inoculum was being recycled.

The root systems were taken to the laboratory for analysis and the advice to the grower was to destroy the whole crop to kill any inoculum it would be carrying and to sterilise the hydroponic solution prior to disposal. It was also suggested that he use a surface sterilant to eradicate the pathogen from the system and to work with a sterilizing system from the beginning next time and to send samples for analysis to confirm the sterilisation is working as it should.

In the laboratory the roots were examined and tested for *Phytophthora* with an LFD. A positive result for *Phytophthora* was recorded. Root tissue was surface sterilized and plated out onto *Phytophthora* selective media and taken back for molecular identification in Egham. This isolate was subsequently shown to be a *Pythium coloratum* (close relative of *Phytophthora*) and known to cause root disease. Interestingly the same *Pythium* species has been also isolated from Black cabbage trees at Dianna’s Peak. As the irrigation water for the Harpers site is fed from the peaks it is not inconceivable that the tomatoes were originally infected by inoculum from the peaks. In addition to the tomato problem the grower had a less dramatic problem in lettuce. The base of the plants had lost integrity, turning brown and becoming slimy. A bacterial pathogen was suspected, and isolations were made in the local laboratory. Samples taken back to the UK were identified using MALDI-TOF and found to be *Pseudomonas cichorii* a recognised pathogen of lettuce known to cause these symptoms. The grower was advised be scrupulously clean in the washing down of equipment, sterilising the hydroponic fluid and using disease free planting material.

Inspections of crops at ‘Horse ridge’, ‘Maldivia’ (James Town) and SHAPE revealed few pathogens. What appeared to be *Verticillium* wilt on brinjal was seen at ‘Maldivia’ and *Alternaria solani* observed on potato seen at ‘Horse ridge’.

Figure 8: Tomato production at ‘Harpers’ showing heavily diseased plants

Figure 9: Positive oomycete test on tomato at ‘Harpers’, shown by the positive ‘T’ line

Figure 10; Diseased lettuce at 'Harpers' *caused by Pseudomonas cichorii*

Figure 11: Staining of the vascular tissue on brinjal taken from the gardens at 'Maldivia' caused by a *Verticillium* wilt

Figure 12: Potato crops at 'Horse Ridge'

Figure 13: *Alternaria solani* on potato at 'Horse Ridge'

Two more pathogens on forestry tree species were recorded during the October/November survey. A rust (*Melampsora* sp.) on *Populus alba* (see figure 14) and an ascomycete (*Corynelia uberata*) on leaves of Cape yew (*Afrocarpus falcatus*) (for details see annex 4.2). In addition, a new, undescribed species of *Ramulariopsis* has been isolated from Jellico (*Berula bracteata*) (for details see annex 4.2). Another non-crop pathogen on St Helena is the rust *Puccinia pelargonii-zonalis* which was widespread on ornamental geraniums. This species seems to be sufficiently host-specific that it does not pose a threat to *Pelargonium cotyledonis* endemic to St Helena.

Figure 14: *Melampsora* sp. rust on *Populus alba* at 'Scotland nursery'

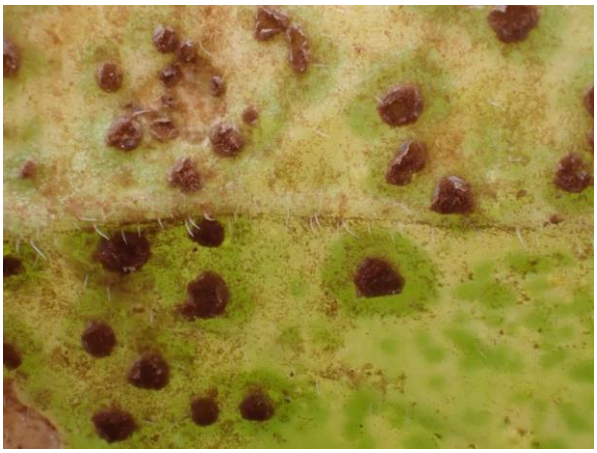


Figure 15: Rust (*Puccinia pelargonii-zonalis*) on ornamental *Pelargonium* at 'Alarm forest'

EPF survey

The first survey of entomopathogenic pathogens was initiated formally in November 2022 with the first visit by Harry C. Evans (5/10/22 to 19/11/22); although ad hoc collections had been made

earlier during the March 2022 plant-disease survey. The latter collections are included in the present report. During the survey, Zac Bargo of the SHRI participated in and assisted with some of the collections as part of a mentoring exercise. The survey strategy involved inspecting the vegetation, from ground level up to head height, as well as the soil and plant litter for characteristic fruiting bodies; typically, the host being affixed to the lower leaf surface. Specimens, together with the substrate to which the diseased arthropods were attached, were collected in sterile plastic tubes and examined in the laboratory for a provisional identification and, where appropriate, for isolation in culture. Subsequently, these were air-dried for 4-5 days and then transferred to sterile plastic tubes for transport to the UK. 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 2022 including figures is provided in annex 4.3.

Some of the collection still remains to be identified and, thus, the fungal-host list above is still provisional. The list is, of course, only a snapshot of the EPF occurring on St. Helena, assembled during a short two-week visit, and EPF incidences will vary according to seasonality and the corresponding fluctuations in arthropod populations. The main finding – and that most feared – is 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. This EPF was first described on a beetle host from Malawi, and later reported from Thailand on stink bugs (Hemiptera). A more recent finding is on the invasive paper wasp, *Polistes chinensis*, in New Zealand. Therefore, unusually, this EPF would appear to have an eclectic host range with a pantropical distribution. 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.

Hopefully, some of these points can be addressed during the second survey. As populations of *Sanctahelenia insularis* are being monitored on a regular basis at the Mt. Vessey site, it is recommended that diseased insects should also be included within the counts – it was estimated that approximately 30 per cent of the population was infected – and that these cadavers should be removed from the site to reduce inoculum pressure.

Another focus will be on the *Aschersonia*-whitefly associations on endemic tree hosts (dogwood and whitewood) – and their mycoparasite complexes – to establish both host and pathogen identifications. It is posited that these EPF, and their mycoparasites, constitute a natural control balance; without the EPF, the whitefly populations could explode – damaging their hosts directly and indirectly (sooty moulds) – without the mycoparasites, the EPF could impact negatively on these, potentially, endemic whitefly species.

Figure 16: *Entomophthora* sp. ined. on Gumwood leafhopper (*Sanctahelenia decellei*) on Gumwood (*Commidendrum robustum*) near 'Millennium Forest'

Figure 17: *Beauveria cf. malawiensis* on Flax weevil (*Sciobius tottus*) at 'High Peak'

Figure 18: Searching for leafhoppers with EPF infection on False gumwood (*Commidendrum spurium*) on 'Mount Vesey'

Figure 19: *Beauveria cf. malawiensis* on False Gumwood leafhopper (*Sanctahelenia insularis*) *Commidendrum spurium* on 'Mount Vesey'

2.2.3 Processing of samples and development of assessment report

Where plant tissue samples were collected in the field they were placed in newspaper or paper envelopes and returned to the newly installed lab at ENRD. In the lab the plant tissue samples were aseptically transferred to a range of solid media to isolate potential pathogens. Where possible plant tissue was removed from the leading edge (area containing healthy and diseased tissue where the pathogen is most active) of a lesion and transferred directly onto *Phytophthora* selective medium (PARP); for other pathogens small sections of plant tissue were first surface sterilised in a 1.5% commercial bleach solution, followed by washing in sterile distilled water before being placed onto a low nutrient medium (tap water agar); for bacterial pathogens the tissue was surface sterilised, washed then macerated before the resulting liquid was transferred onto a nutrient medium. The samples were observed daily and where organisms grew from the plant material, they were aseptically transferred to individual plates of either potato dextrose agar (for fungi and oomycetes) or nutrient agar (for bacteria). All isolates were taken to CABI UK under Defra licence for identification. The isolates from Trip 1 and Trip 2 are still in the process of being identified and a full technical assessment report will be produced in Y3 including methods used, results and conclusion/recommendations which will feed into the Action Plan.

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*

It is still too early in the project to make any definitive judgments on treatments and best practice procedures as these can only be developed based on knowledge of the pathogens identified

through surveys and pathogenicity experiments. In particular, the results of the pathogenicity experiments are crucial to establish the causal agents behind the tree dieback. However, progress in producing seedlings of a suitable size to conduct such experiments was slower than anticipated. This has been reported to Darwin in form of a change request asking for a shift of this activity including the associated budget into the next project year. However, the discovery of a range of serious soilborne plant pathogens within the National Park has already led to the formation of the task force involving all major stakeholders active on St Helena. This includes the implementation of emergency measure including a significant restriction of access to infected sites or sites particular sensitive for conservation. Other measures include detailed phytosanitary measures, which all personal working in the vicinity to infected or sensitive sites are required to adhere to.

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.

4.1.2 3 workshops held on St Helena to train relevant stakeholders in diagnosis of diseases and best practice for efficient control.

During the second visit Jayne Crozier and Phil Taylor provided four customised training sessions to each group of attendees (some photographs provided in annex 4.6). The first training was provided to St Helena Active Participation Enterprise (SHAPE), an organisation providing occupational therapy for those with learning difficulties. The training was simplified to make it suitable for the participants and after some initial hesitancy they threw themselves into the training and learnt a considerable amount about diagnostics. News spread that the training had been a success which helped to overcome the initial hesitancy of other participants of the following workshops.

The second training session took place at Kingshurst Community Centre and was primarily aimed at forestry and conservation staff - 24 staff attended the workshop in total.

Figure 20: Group photo at the end of the training at the Kingshurst community centre.

Figure 21: Onsite training on *Phytophthora* phytosanitary measures

A questionnaire was provided at the end of the course which comprised of tick boxes and free text areas.

Table 1: Summary of the feedback from workshop questionnaires at Kingshurst Community Centre

	5	4	3	2	1	NA
	Strongly agree			Strongly disagree		
I learned new knowledge skills from the course	18	1				
2 I am confident in my ability to use the knowledge skills learned from the course	11	3	5			
3 The course was a worthwhile investment for my organisation	14	3		1		
4 The course was relevant to my work	9	3		1		
	High extent			Low extent		
5 to what extent will you apply the knowledge skills learned from the course	11	8	1			
6 How will the knowledge skills learned influence your job performance	9	9			1	
	Very important					
7How important is the use of the content of the course to the success of your job	11	5			1	

Most often given answers to the question *'Which parts of the course did you find particularly useful?'* were: Grouping of pests and problems; Identifying the types of problems on plants'; All (five replies indicated they found the whole course useful); Pictures; Presentations; Nutrients

Answers to the question *'Do you have any suggestions for improving the course?'* were: Request for longer course; More course material

Other comments included: Continue the way you did today; I enjoy the whole course well layout and easy to understand; very enjoyable; I enjoyed this course it will help me move forward with a lot of things; I enjoy this course and all the knowledge which we learn will benefit in every way; I feel I would need to learn these topics more however the course was very good

In a similar manner ENRD and conservation staff were given a similar training to that of the forestry staff at the laboratory in Scotland. This was similar to the forestry training but with more technical information. The feed-back questionaries were positive.

Table 2: Summary of the feedback from workshop questionnaires at Scotland

	5	4	3	2	1	NA
	Strongly agree			Strongly disagree		
I learned new knowledge skills from the course	7	2				
2 I am confident in my ability to use the knowledge skills learned from the course	1	7				
3 The course was a worthwhile investment for my organisation	8	1				
4 The course was relevant to my work	9	1				
	High extent			Low extent		
5 to what extent will you apply the knowledge skills learned from the course	6	2				
6 How will the knowledge skills learned influence your job performance	5	3				
	Very important					
7How important is the use of the content of the course to the success of your job	9					

Answers to the question *'Which parts of the course did you find particularly useful?'* were: Leaf spots / Nutrients; The whole of the course was very useful/beneficial to my current job; I found all parts of the course very useful in the field of work I do; All; Whole course was useful as all will be used in day to day activities but also help in building confidence; The whole course has been

very useful to me; The entire course was very useful to me as I have learnt a lot where I can share this information with others it also broaden my knowledge in this field.

Answers to '*Do you have any suggestions for improving the course?'* included: Possible extra time for practical exercises otherwise level of course very good; Further course related to this one; Need more time to be able to discuss certain issues if we wish to; Probably more practical work in the field; Probably doing more practical work in the field identifying virus bacteria fungi.

Other comments included: Thank you for a very well-presented training course, this has broaden my knowledge and also I feel to train others has given me confidence; The whole of the course was very useful particularly in my job an also being a part time farmer; I find the course very useful and interesting an also learnt a lot did broaden my knowledge. Thank you for sharing your knowledge; Brilliant training session really beneficial for both personal and work- related issues; Very good workshop.

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

As part of the second visit to St Helena Jayne Crozier and Phil Taylor provided training to eight students from Prince Andrew secondary school at the agricultural education centre at 'Harpers' within the school grounds. The afternoon of training comprised a mix of seminars and interactive sessions centred around crop diagnostics. This training was developed specifically for this group and was substantially different form that provided to the forestry or ENRD staff. The students listened to the presentations, but became fully engaged when they were invited to gather diseased plants and perform a field diagnosis on their material. The teacher who attended the class and the students all enjoyed the training. Although planting and tending trial plots may be a valuable learning experience for students, it was considered not practical to undertake such activities within the limited timeframe of the project. Additionally, due to the lack of staff available to supervise these activities outside of our team visits to the school, it is not feasible to include them in the project.

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

The list of equipment and consumables as outlined in the proposal was agreed on by all project partners. A list of purchased items was provided in the previous annual report. As most of the equipment was already installed and ready for use by March 2022 this activity was covered earlier than planned. The need for additional equipment was identified at the end of the first visit in March 2022, purchased in the UK and shipped to St. Helena in July 2022. During the second visit a camera and tablet were taken for use in the field and lab for record collecting. The additional equipment including a new microscope and centrifuge were shipped to St Helena and arrived during the second visit but were not released from the port until after the visit was over.

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 project year. Later in 2022 the training was building on this and included the use of a laminar flow cabinet, autoclave, compound and stereo microscopes, media preparation, isolation of pathogens from plant samples and some key features of some of the fungal groups encountered. On the job training took up considerable time but was essential to jointly kickstart the pathogen surveys. This was then complemented by remote supervision of lab activities via Zoom and the diagnostics course provided during October 2022.

3.2 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 40 records, which served as the starting point for the development of the database of St Helenian plant pathogens. The database has been added to following the two visits to the island with more than 60 samples identified from crop plants and 157 from endemic vegetation. In addition, 18 entomopathogenic fungi have been collected and identified from endemic and introduced infects. The details can be found in the database in annex 4.1. 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. Furthermore, BiFoR have also started the planned molecular processing of samples collected during the initial visits. 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.

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

Despite frustrations expressed by the farmers we met regarding the problems of pest and pathogens attacking their crops, our initial survey of the diseases of agricultural crops indicated that many common, what could be considered ‘universal’ crop pathogens, were absent. This does not necessarily mean that these diseases are not present on the island as the time of year, environmental conditions and crop variety all influence disease expression. To get a more complete picture of the diversity of problems, surveys need to be conducted at different times of the year across a variety of agricultural production areas. In the initial surveys, coffee and bananas were almost free of disease, despite no attempts to control pathogens.

It is important to note that the two visits made can only provide a limited snapshot of the overall crop disease situation. Nonetheless, several significant crop pathogens that negatively affect yields have already been identified, and further field visits are expected to yield additional insights. At this stage, it is not possible to prioritize or rank individual diseases based on their importance.

Ongoing efforts to identify isolated pathogens at CABI are underway, with several potential pathogenic genera already identified, including *Phytophthora, Pythium, Fusarium, Ilyonectria, Phomopsis* and *Erwinia*. However, further work is required to validate their pathogenicity. Unfortunately, the current lack of seedlings and adequate facilities in St Helena poses a significant obstacle to this critical step. Consequently, urgent efforts are being focused on securing the necessary resources to complete this vital activity. Once completed, this will provide crucial insights into the severity and scope of the disease threats posed by these pathogens. Despite delays in pathogenicity training 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.

As the cause(s) of the tree diseases are currently unknown it is not possible to provide detailed information on the how to mitigate the threats however there are principles of phytosanitation that can be applied which will broadly reduce all threats.

Thus, a phytosanitary regime was proposed to minimise the potential for inadvertent and accidental transfer of pathogens from one region to another. This regime has been adopted by the ENRD.

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

A major step towards this output has been achieved through the refurbishment of the pathology lab at ENRD (St Helena; Scotland site) with a comprehensive set of equipment necessary for isolation and morphological identification of pathogens. A major focus of the first visit was on training staff in the use of the equipment for processing samples of crop and tree diseases.

Where local expertise is not yet sufficient, there is the capacity to take digital photomicrographs and to send images to CABI for identification.

5. Pathogen treatments implemented.

Due to the undetermined cause of the problems on the endemic trees it was not possible to provide any treatments at this stage. However, advice was provided in the growth conditions of the seedlings in the nursery.

3.3 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 18 months of the project the team has made two visits to the island and collected and identified samples from endemic and agricultural plants found in range of habitats. In addition, a pathology lab has been set up and initial laboratory training given to local staff for the identification of plant pathogens. A major focus of the second project year was on providing training to growers in diagnostics and several workshops were held in October and November 2022. A further focus has been to implement emergency measures to prevent further spread of potentially serious pathogens belonging to the oomycetes after their initial detection in 2022. Although the pathogenicity of these agents is yet to be confirmed through re-inoculation experiments (planned for the coming year), putting in place precautionary phytosanitary measures was seen as a top priority. The urgent need for improved phytosanitation in the peaks area has had significant knock-on effects on other research projects and conservation activities currently ongoing on St Helena. This project has also dedicated some resources to coordinate with local stakeholders through the newly established Phytophthora task force.

Despite this unforeseen development, the project's activities are still progressing as planned and the outcome is expected to be delivered as scheduled. One positive outcome of the project so far is an increase in local capacity to manage insect pests and plant pathogens, as the project has provided advice on chemical use and phytosanitation.

It is important to note, however, that it is still too early to provide evidence of a full delivery of the outcome at this stage. Further evaluation and monitoring of the project's progress will be necessary to determine its overall success.

3.4 Monitoring of assumptions

The delayed start of the project means that this annual report covers a period of 18 months rather than 2 years had it started on time. 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. 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.

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 are 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 in order 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 restriction 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 in a flexible manner to accommodate commitments of stakeholders.

Assumption 4: All partners and their staff deliver timely on their commitments to the project. Interactions with the partners has 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. There is however the need in the coming project year to apply to APHA for an expanded licence to cover a broader range of pathogens, initially imported for identification only, to conduct host range testing under quarantine conditions. A provisional meeting has been held with the licencing authority to discuss requirements for the expanded licence

Assumption 8: Access to the infected parts of the infected trees is easily possible. This has not been a major issue up to this point. However, given the protected nature of the endemic trees, destructive sampling has been kept to a minimum, this could potentially impact the surveys for pathogenic organisms, especially those affecting internal plant structures. The recording of potentially pathogenic fungi and oomycetes during this project has led to strict quarantine being implemented in the peaks area and restricted access to sensitive areas. Further surveys in the Peaks area will require a more coordinated approach and approval of St Helena authorities prior to every field site visit. This is not anticipated to be a significant problem as the project involves all relevant stakeholders involved in the managements of the Peaks area.

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 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 restriction in place on St Helena or the transit country South Africa. No travel delays have so far occurred due to adverse weather conditions.

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 challenging to identify using molecular means. The *Phytophthora* which has been strongly implicated with tree decline, belongs to a group of very closely related and inbreeding species identified as Clade 8a. To assist with identification support has been sort from external *Phytophthora* experts. We are currently discussing complementary funding with Defra to address the urgency of dealing with the decline in the endemic trees on the island. The funding is mainly aimed at monitoring the distribution and spread of the target pathogens.

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. 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.
Assumption 13 Timely availability of facilities to hold workshop on St Helena. Stakeholders are keen and available to engage. There have now been several 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 ENRD facility and were open to all staff on site and the public.

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

Invasive species and climate change were identified as core biodiversity challenges by the majority of the respondents to Defra's recent Call for Evidence on 'Safeguarding the Environment in British Overseas Territories' (second only to the threat from economic development as an issue). Both factors are also recognised to pose major challenges for agriculture and food safety within the OTs. It is anticipated that at least a proportion of the plant pathogens on St Helena are likely to belong to non-indigenous invasive taxa and their impact is likely to become more prevalent with a changing climate. The aim of this project is to support the "futureproofing" of St Helena against the heightened risks posed by pathogens. This will be achieved through the development of management procedures that enhance the prevention of the introduction and establishment of additional pathogens. Additionally, the project seeks to mitigate the impact of pathogens that are already present on St Helena.

As the project is still in the early stages none of the anticipated beneficial impacts on biodiversity and poverty alleviation have been achieved. However, some significant foundations have been laid towards achieving these impacts:

- Significant steps towards identifying the disease complex most likely underlying the dieback of several endemic tree species.
- Identification of a number of important crop diseases lays the foundation for improved crop management leading to poverty alleviation.
- A first round of training workshops has already contributed to a better capacity to diagnose plant pathogens.

5. Gender equality and social inclusion

During the first 18 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].	50%
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].	75% (this includes ENRD, SHRI, BiFoR and CABI)

6. Monitoring and evaluation

Regular project monitoring has so far been conducted through meetings and briefings via audio/video links, including the monitoring of progress against project outputs. This will be continued by CABI and project partners throughout the project. The achievement of milestones has been regularly checked against the 'Implementation Timetable' during the zoom meetings and while meeting in person on St Helena. Part of the monitoring is also the Darwin Plus reporting (six-monthly progress reports and annual project reports). The reports, as well as all published outputs, are generated as collaborative activities, with responsibility shared equally between the project teams on the OTs and the UK. Progress achieved to date has also been reviewed by all team members during the writing of this report. The activities conducted within individual work packages of this project are expected to impact to a considerable degree on the conduct of subsequent work packages, both with regards to the anticipated time frame or applied methodology. However, as the work packages of the project need to be conducted sequentially to a certain degree, towards the end of each package a limited evaluation to agree necessary adjustments is always undertaken. At these points in the project during consultation with involved stakeholders we evaluate ongoing activities and modify procedures whenever required.

By the end of the project, the team will evaluate whether trained personnel are able to continue with plant disease identification and management independently. This will mainly be evidenced by work reports and through forward work planning beyond the life of this current project. CABI uses the PRINCE2 ™ project management methodology to manage and implement all its projects, ensuring that communication is maintained between collaborators, and with the project's sponsors through structured reporting and clear communication channels. CABI has retained overall financial control over the project, and all partners account specifically for funds provided to them. The final project report and any publications based on the results of this project will be peer reviewed, internally by senior scientists in CABI, internally within the DI (if required) and externally before submission.

7. Lessons learnt

Overall, the project team worked extremely well together, despite some minor technical communication problems caused by the extreme geographical distances between individual project partners. Communication via the internet is very expensive on the island and connection speeds are slow, this can hamper desk-based studies when on the island. 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

[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.

invasive invertebrate control' and the FCDO (CSSF) funded Cloud Forest Project 'Restoring St Helena's Internationally Important Cloud Forest for Wildlife, Water Security') has already led to very useful synergistic activities and are anticipated to benefit outcomes and lead to improvements of the individual projects. Whilst preliminary, the findings and implications of the most recent visit were shared through a short seminar with all partners at the end of the trip. This included forestry workers, ENRD as well as NGOs those involved in the cloud forest project.

Figure 22: Staff and interested parties assembling in the seminar room in Scotland to hear the news of the status of pathogens on St Helena.

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

Comment 1: Please provide more information on BiFOR's inputs to the project, and how gene sequencing is being applied to the problems being addressed, including the work of their PhD student on the identification of putative pathogens isolated from cloud forest trees.

Amy Webster the BiFOR PhD student has been screening eDNA isolated from diseased black cabbage leaves, soil and wood with commercially available primers. Based on the putative pathogens isolated by CABI, the screening assays have focused on identifying *Phytophthora* sequences at a genus level and more specifically *Phytophthora Clade 8a pathogens* and four *Erwinia* species, two of which are known to be plant pathogens or antagonists (*E. amylovora, E. pyrifoliae, E. billingiae* and *E. tasmaniensis)*.

Although no *Phytophthora* has been isolated from Black cabbage trees, interestingly DNA analysis has revealed the presence of *Phytophthora* in the soil surrounding black cabbage trees. This result needs to be treated with caution as the amplification came from mixed community eDNA and it is not possible to confirm this result with Sangar sequencing or to a species level.

To progress this line of investigation DNA from 12 of the *Phytophthora* isolates are being prepared for whole genome sequencing using the gridION at the university. As this method uses nanopore technology, long read sequences, will be generated. This will be the first whole genome available for the isolates, which can then be used as a reference genome throughout the rest of the project.

The genome will be used to distinguish the ID of the *Phytophthora* species which cannot be determined using individual loci. A multi-loci phylogenetic analysis (see Fig. 23) shows clustering of the isolates with the species "*P. kelmania*" also known as *P. kelmanii* and that the species falls within the *P. cryptogea* complex. It is possible that the whole genome sequencing, may reveal a previously uncharacterised species. From these data primers will be developed to provide a species-specific qPCR assay to identify and quantify the *Phytophthora* within samples.

Based on multiloci analysis, all isolates of *Phytophthora* from St Helena appear to be identical, but the aim is to do further whole genome analysis on *Phytophthora* isolates from various endemic tree species, Scotland and Peak nurseries and water sources on the island.

In parallel to this work testing of leaf samples for the presence of *E. billingiae is being undertaken.* This bacterial pathogen is known to induce tip dieback so was selected for further research. The first assessment appears to show presence of *Ewinia* across nearly all 12 of the focal trees that are included in the monthly monitoring. However, this needs further assessment for confirmation.

In addition to the isolations undertaken by CABI Amy has also conducted her own isolations from infected black cabbage tree material. She has accumulated a collection of 31 bacterial species which she has putatively identified through the MALDI-TOF and is now analysing with 16s sequencing. Likewise, she has approximately 25 fungal isolates awaiting ITS identification. These samples will be added to the microbiota records and any known pathogens further investigated to improve our understanding the disease seen in black cabbage trees.

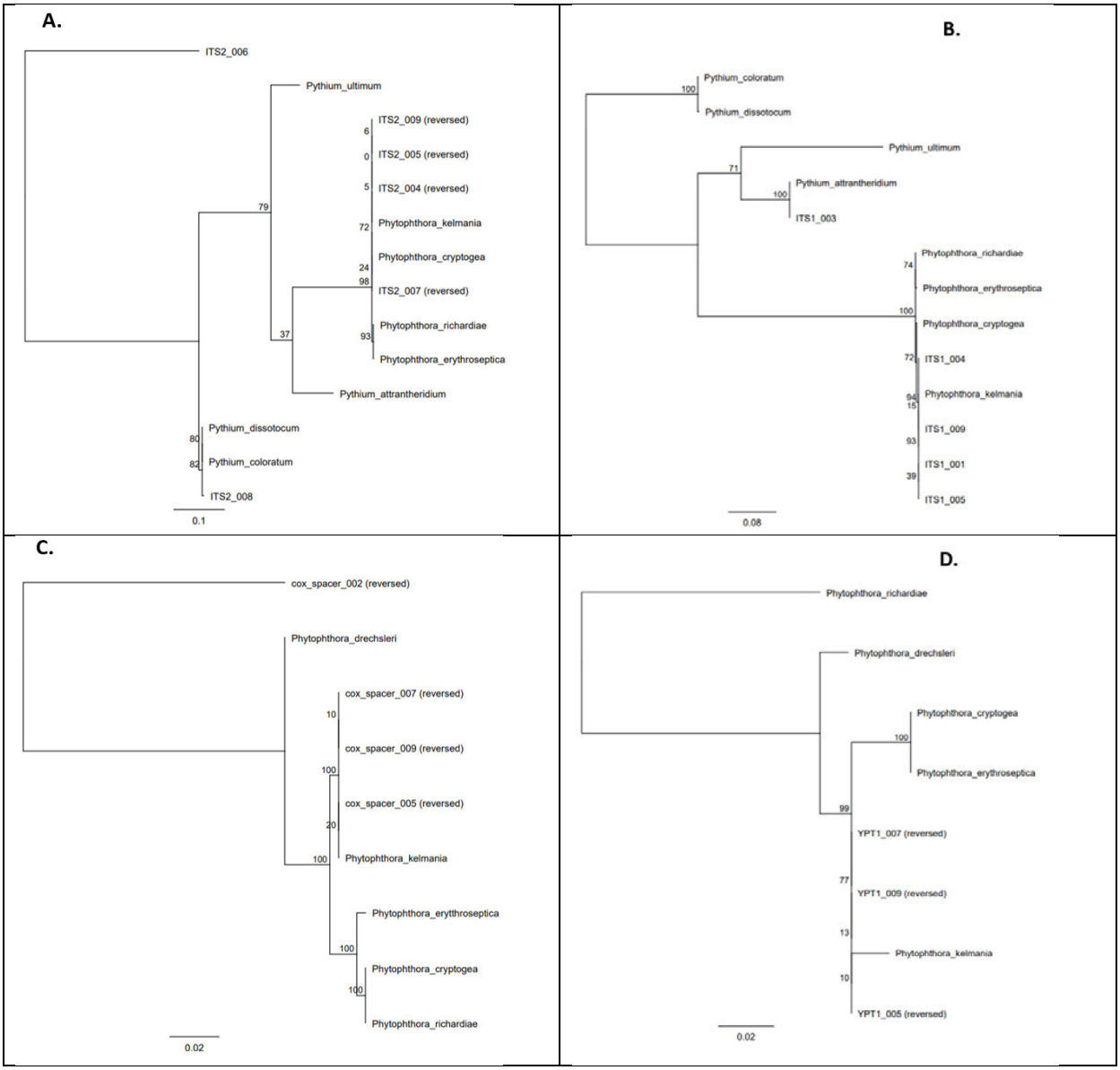


Figure 23: Phylogenetic trees showing the clustering of several *Phytophthora* species, *Pythium* species and unidentified isolates from St Helena based on an individual loci. Tree A was built using ITS1, tree B with ITS2, tree C with the cox-spacer region and tree D with the YPT1 gene. All sequences were aligned using Geneious alignment with automatic detection of read direction. The trees were then created using RAxML with 100 bootstraps, and the best fit maximum-likelihood tree was used.

Comment 2: Output indicators should be revised so that they provide a measure of the change or quality expected due to the successful delivery of the Output – rather than simply being, as at present, an Activity that has taken/will take place (e.g. production of a report; database or Action Plan). This was also suggested in the Stage 2 DEC feedback letter: some changes were made but the indicators are still not SMART.

This has been addressed by the project team and a revised logframe with updated output indicators was submitted to Darwin in December 2022. The revised logframe is also attached to this report with changes highlighted in yellow.

Comment 3: Please provide information on how the project addresses specific St Helena strategic biodiversity and environmental priorities (Section 4 of AR)

Under the new Ministerial System, the St Helena Government has set out its vision and strategy for 2022-2025. The strategy supports the existing St Helena Government Ten Year Plan (2017-2027) and Sustainable Economic Development Plan (2018-2028). The vision is "A sustainable environment that creates opportunity and inspires social and economic progress ensuring a better quality of life for all". There are seven expected high-level outcomes, two of which are relevant to the DPLUS157.

Altogether Wealthier: Our communities feel the benefits of economic growth by being in-work and enjoying a good quality of life. St Helena becomes more financially sustainable through increased exports and reduced imports and less reliant on aid. One of the four Strategic Objectives that fall under the outcomes that DPLUS157 is actively supporting is 'SO.13 Increase export of goods and services', by increasing St Helena's capacity to identify and manage the pathogens that threaten food crop production.

Altogether Greener: We value and enjoy our built and natural environment and protect and enhance it for future generations. Achieved through continuously enhancing our efforts to develop, protect, conserve, and promote sustainable use of our environment. Of the five Strategic Objectives under this outcome, DPLUS157 directly supports:

SO. 25. Continuously enhance efforts to develop, protect, conserve and promote sustainable use of our environment and

SO.26. Maximise the potential of Blue and Green resources. Indirectly it can be considered to support two others through the knowledge gained but the project can be expected to support through improving understanding and knowledge base, increasing our knowledge of the known pathogens affecting St Helena's biodiversity and food security, alerting biosecurity to known pathogens and raising awareness of risks associated with introduction of new pathogens to St Helena, informing biosecurity protocols and help improve disease management in agriculture.

SO. 23 Develop policies which encourage local production so that people have access to sustainable supplies of fresh produce.

SO.24. Maintain food security by implementing policies and legislation to enable the expansion of our agricultural and fishing sectors and encourage import substitution.

9. Risk Management

New risks have arisen from the discovery of *Phytophthora* and other oomycetes, which are very likely the causal agents behind the tree dieback, and which pose a severe threat to the survival of many St Helena's endemic trees and their associated invertebrate fauna. As a result, immediate emergency measures have been put in place, which currently restrict access to sensitive sites, not only for the project team, but also for other scientists working on additional research projects. Further access to conduct the outstanding survey for EPFs will be more limited than originally planned but should still be possible to be covered. Furthermore, 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 is significantly beyond the scope of this project and the necessary complementary funding is currently being discussed with Defra.

10. 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 is an urgent request for complementary funding to upscale investigation into 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.

11. 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 where the project team described what they would be doing on the island. This was followed by an update on project developments through a newspaper article. 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.

We have contacted the biology department of Prince Andrew secondary school, which has led to a first training and engagement session with the pupils of the school in October. This engagement will continue in the coming year.

A this stage our exist strategy (see below) is still valid and no changes are required:

'The fundamental design of this project, with its focus on training and capacity building across multiple sectors and has been chosen with long-term sustainability in mind. Ongoing technical support from ENRP to growers based on the provided training after the termination of the project. To secure gained capacity beyond the lifetime of the project, methods for improved management will become part of the ongoing advisory service and both farmers and advisory staff will be trained to make use of any future developments in the CABI diagnostic and advisory online services. Through these tools we will continue to provide assistance remotely on newly arrived pathogens or outbreaks of pests or diseases.'

12. Darwin Plus identity

The Darwin logo was represented on slides in a presentation introducing the project during the visit to St Helena, to which many stakeholders and the public had been invited. The project was also presented during a radio interview on St Helena in March 2021. During this interview the aim and purpose was explained and the Darwin Initiative was specifically mentioned as the main funder of the overall project.

All project activities are presented as a distinct project with a single identity.

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'

13. Safeguarding

Has your Safeguarding Policy been updated in the past 12 months?		No
Have any concerns been investigated 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. 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

14. Project expenditure

Table 1: Project expenditure during the reporting period (1 April 2022 – 31 March 2023)

Project spend (indicative) in this financial year	2022/23 D+ Grant (£)	2022/23 Total actual D+ Costs (£)	Variance %	Comments (please explain significant variances)
Staff costs	[redacted]			
Consultancy costs				
Overhead Costs				
Travel and subsistence				
Operating Costs				
Capital items				
Others (Please specify)				
TOTAL	**£60,237**	**£60,302.68**		

Table 2: Project mobilising of matched funding during the reporting period (1 April 2022 – 31 March 2023)

	Matched funding secured to date	Total matched funding expected by end of project
Matched funding leveraged by the partners to deliver the project.	[redacted]	
Total additional finance mobilised by new activities building on evidence, best practices and project (£)		

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 Secretariat to publish the content of this section (please leave this line in to indicate your agreement to use any material you provide here).

File Type (Image / Video / Graphic)	File Name or File Location	Caption, country and credit	Online accounts to be tagged (leave blank if none)	Consent of subjects received (delete as necessary)
				Yes / No
				Yes / No

Annex 1: Report of progress and achievements against logframe for Financial Year 2022-2023 – if applicable

Project summary	Measurable Indicators	Progress and Achievements April 2020 - March 2021	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.		The first visit to St Helena, was delayed and took place at a time, which we did not consider optimal for pathogen surveys. Despite this, we have broadly achieved what we set out to do during the first two years (which was in effect only 1.5 years). As a result, we have been able to catch up on our schedule. The findings from the initial two field visits have provided a solid foundation for us to move forward in 2023. We anticipate that all deliverables will be completed as planned.	
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	1.1 Best practice put in place for habitat management in cloud forest, and afforestations with 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.	The second project year included an intensive field visit by four CABI scientists and the collection of further microbial pathogens from endemic trees, native plants, crops and insects. This led to the isolation of several pathogens likely to be the causal agents of the dieback of the endemic trees. Equally, pathogens causing the most widespread crop diseases on St Helena have been isolated and await identification. Training of growers and extension staff intensified considerably and altogether three workshops were held in this year. This increased on island capacity to diagnose plant disease considerably. Training of ENRD and SHRI staff to independently work in the pathology lab (installed the previous year) continued. At present, the project activities are proceeding as scheduled and we are on track to deliver the desired outcomes. The project has already increased the local capacity to manage insect pests and plant pathogens by providing guidance on chemical use and phytosanitation. Nonetheless, it is premature to provide conclusive evidence	Key actions for 2023/24 will be: • Conduct a second survey of EPFs to cover a different seasonal aspect • At least two additional training workshops conducted on site in 2023 with a focus on disease management • Continued cataloguing of newly recorded pathogens • Construction of quarantine facilities in St Helena for pathogenicity testing • Start the pathogenicity testing experiments to confirm causal agents of tree diseases (delayed due to slow growth of tree seedlings, which has led to a shift of activity and budget into year 3 (approved by Darwin after the submission of a change request)

Project summary	Measurable Indicators	Progress and Achievements April 2020 - March 2021	Actions required/planned for next period
		regarding the full delivery of the outcome at this stage.	• Increased focus on action plan
Output 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.	Existing literature and other knowledge sources have been systematically reviewed for records of plant pathogens from St Helena. Although scant and rather general, this information is the starting point for the newly developed database of St Helenian plant pathogens. This initial database is constantly being updated and more than 60 samples have been identified from crop plants as well as 157 from endemic vegetation. In addition, 18 entomopathogenic fungi have been collected and identified. The details can be found in the database (annex 4). In addition, the molecular processing of samples through BiFoR has continued during the last year as planned.	
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.		This activity was completed 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 records are nonetheless important and are included in the first version of the of the project database now established and attached as annex 4 to this report. During the first visit to St Helena the library of ENRD and plantation house (seat of the governor) were searched for useful information. However, most information was found to be unspecific (e.g. blight on tomato). The database will remain open throughout the life of the project for further records to be included.	Although this activity is completed the database remains open to include any additional information the team will discover during the remainder of the project.

Project summary	Measurable Indicators	Progress and Achievements April 2020 - March 2021	Actions required/planned for next period
Activity 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 beyond the termination of the project.		The latest version of the database including the results from the literature research and records collected during the first two 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 second project year, some samples collected during the visit are not yet processed and entered.	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.	2.1 The status and impact of the plant pathogens, and vectors of cloud forest species is known by Y3Q3. 2.2 The status and impact of the pathogens and vectors of economically important crops (including forestry) finalised by Y3Q3. 2.3 The assessment providing the status and impact of entomopathogenic fungi present on St Helena produced by Y3Q3.	Despite frustrations expressed by St Helenian farmers regarding the problems of pest and pathogens attacking their crops, our surveys indicated that many, what could be considered universal crop pathogens, were absent. Coffee and bananas were almost free of disease despite no attempts to control pathogens. The situation was different for horticultural crops where we found many of the common plant pathogens that you would expect, some of which were severe and clearly reducing yield. Our surveys of the trees of the cloud forest indicated that there were several problems taking place taking place simultaneously. For example, on the black cabbage trees there were leaf spotting pathogens, tip dieback and total tree dieback. The relationship between these symptoms and the causes involved is a matter of on-going research.	
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 assessment finalised by Y4 Q3		As the first visit in 2022 coincided with the end of the normally drier summer season when fewer crops were available, the timing was not considered optimal for pathogen surveys. Due to these limitations the focus was primarily on getting a better understanding of the existing problems, both regarding food security and tree dieback. The second visit was planned to align with early summer, providing an opportunity to refine project activities for the remainder of the timeline. Through extensive surveys conducted in both cloud forest and cultivated areas, we gained a comprehensive understanding of the scope of issues posed by plant pathogens in farming and	Assessment of samples and identification of likely causal agents of the tree dieback collected in year 1 and 2 will continue in year 3. This will be supplemented through additional site visits later in 2023. A major part of the work outlined for 23/24 is conducting pathogenicity experiments on disease free seedlings to establish which pathogens are responsible for tree death and dieback.

Project summary	Measurable Indicators	Progress and Achievements April 2020 - March 2021	Actions required/planned for next period
		forestry. These surveys allowed us to evaluate the extent of tree dieback and crop damage, and highlighted the significant threats that plant pathogens pose to biodiversity. Diseases symptoms were found on Black cabbage, He cabbage and Whitewood and repeated samples (including soil samples) were taken for further assessment. The species most severely affected by plant pathogens are Black cabbage and Whitewood and both species show an alarming level of decline. A Phytophthora species belonging to clade 8a has been isolated from dying whitewood, dogwood, redwood and She cabbage. The death of She cabbage is particularly concerning as this species seldom produces seeds, which are only viable for a very short period. A number of other pathogenic genera have been identified from dying plants and may be implicated in the decline. These include *Fusarium, Ilyonectria*, *Phytophthora* and *Pythium.* All of these putative pathogens require pathogenicity testing to establish, which of them are the causal agents behind the dieback.	
Activity 2.1 .2 Second on site survey for tree pathogens by BIFoR PhD student		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 a change request was submitted asking for a delay of Amy Webster's visit to St Helena and the CABI staff supervising her activities. This also included a shift of associated funds - the change request was approved by Darwin in January 2023.	The visit is now scheduled to take place around October 2023.
Activity 2.1.3 Processing of samples and development of assessment report		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	This activity will continue throughout 2023/24 as more diseased trees have been discovered over recent months. Updates on the identification progress

Project summary	Measurable Indicators	Progress and Achievements April 2020 - March 2021	Actions required/planned for next period
		diseased trees. Initial isolation of pathogens from leaf, branch and trunk tissue was undertaken at the newly refurbished ENRD 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 second visit in 2022 has been finalised, but molecular identification is still ongoing. Preliminary results are provided in annex 4.1	will be provided in the next half-year and annual report.
Activity 2.2.1 First onsite survey of crop and forestry pathogens as well as EPFs including farmer interviews		The first survey of crop and forestry pathogens had been completed in the previous project year and results were provided in the previous annual report. As the timing of the first visit was not considered to be optimal for a survey of EPFs, this was shifted into the next year and results of this survey are presented in this report.	Completed
Activity 2.2.2 Second onsite survey of crop and forestry pathogens as well as EPFs		This was conducted for crop and forestry pathogens in October/November 2022 to cover a different season. However, due to unseasonably prolonged cold weather, not many additional pathogens were discovered compared with the first visit. There is however a new pathogen recorded associated with cape yew, which is an important forestry species on St Helena.	A second survey of EPFs will take place later in 2023 to cover a different season. This will include also the visit of additional sites.
Activity 2.2.3 Processing of samples and development of assessment report		First results were already represented in the previous annual report and additional records are presented in this report.	Work on an assessment report has already started and will continue throughout 2023/24.
Output 3. Action plan to mitigate priority identified threats developed with and made available to all stakeholders	3.1 Action plans for at least 4 priority threats to cloud forest species and/or economically important crops produced by Y3Q2.	No formal action plan has been finalised at this stage; a significant amount of emergency phytosanitary measures have been implemented to prevent further spread of pathogens within the Peaks.	

Project summary	Measurable Indicators	Progress and Achievements April 2020 - March 2021	Actions required/planned for next period
Activity 3.1 Action plan to mitigate identified threats in all assessed sectors developed jointly with and made available to all stakeholders		The repeated isolation of a soilborne Phytophthora from dying endemic plants makes this pathogen a strong candidate for the tree dieback observed on St Helena. Based on this discovery and the reported threat posed by 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, we have started to apply for complementary funding to allow an upscaling of diseases research and monitoring of spread, which is beyond the scale of this project.	Work on the action plan will continue as planned in year 3. The action plan is contingent on the identifications of the pathogens collected during the first two site surveys and the results from pathogenicity experiments.
Output 4. Capacity for St Helena to address threats caused by pathogens independently increased.	4.1 At least 30 stakeholders including 10 farmers and 8 women attend each of the three workshops on St Helena during the project, and trained in the diagnosis of diseases and best practice for effective control. 4.2 Upgraded Laboratory by Y2Q4. 4.3 At least 6 staff trained in the use of diagnostic facilities by CABI staff by Y4Q1. 4.4 Access to data and information about known pathogens of St Helena available online by the end of the project.	A major step towards this output has been achieved through the refurbishment of the pathology lab at ENRD (St Helena; Scotland site) with a comprehensive set of equipment necessary for isolation and morphological identification of pathogens (see photos). A major focus of the second visit was on training staff in the use of the equipment for processing samples of crop and tree diseases. Where local expertise is not yet sufficient, there is the capacity to take digital photomicrographs and to send images to CABI for identification.	
Activity 4.1.1 Development of training material based on action plan		Training material based on CABI's Plantwise program had been developed prior to the conduct of workshops.	Work on training material will continue as planned in year 3 and focus on disease management.

Project summary	Measurable Indicators	Progress and Achievements April 2020 - March 2021	Actions required/planned for next period
Activity 4.1.2 Three workshops held on St Helena to train relevant stakeholders in diagnosis of diseases and best practice for efficient control.		Three workshops have been held on St Helena in October 2022 targeting extension, research staff and commercial and other growers. This round of training has been mainly focused on diagnostics and was well received by attendees.	A second set of training workshops, focusing on disease management is scheduled to take place during the next team visit to the island.
Activity 4.1.3 Student and community engagement through trial plot at Prince Andrews School; ongoing supervision onsite by SHRI and ENRD		Training was provided at the school in October 2022. However, it was recognised that installing a new trial plot at the premises of the school was not feasible as there was insufficient time available for regular supervision of activities.	Teaching of students is scheduled to continue for later in 2023.
Activity 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		As most of the equipment was already installed and ready for use by March 2022 this activity was covered earlier than planned. Whilst working in the new lab during the first visit the need for some additional equipment and further consumables was identified (e.g. loops, additional, spirit burner, racks, sample storage boxes, a tablet for recording field data, field cameras with high-quality close-up function, minicentrifuge), and these items were purchased on return to the UK and arrived on St Helena in November 2022.	Further training on the use of new equipment during the next team visit later in 2023.
Activity 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		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 visit in October 2022.	Further training on the use of new equipment during second team visit later in 2023.

Project summary	Measurable Indicators	Progress and Achievements April 2020 - March 2021	Actions required/planned for next period
Output 5. Pathogen treatments implemented.	5.1 New Treatment measures tested during Y3Q2 to Y4Q2. 5.2 Initial efficacy of treatments assessed by Y4Q3.	Due to the undetermined cause of the problems on the endemic trees it was not possible to provide any treatments at this stage. However, advice was provided in the growth conditions of the seedlings in the nursery.	
Activity 5.1 Implementation of treatment measures starting during Y3 Q2		Based on the results of the first two surveys we have a good understanding of which of the pathogens are of highest importance for growers on St Helena.	In line with the planned next round of training workshops; which will focus on diseases management; joint field site visits with growers and extension services are planned for 2023 aiming at providing on site advice on improving management specifically targeting plant disease.
Activity 5.2 Efficacy of treatment surveyed in crops and with nursery stocks in Y3 Q4		This has become difficult to survey as no baseline data on yield have been previously recorded and growers are not able to provide exact measures of current yield levels.	Advice will be provided 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			
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. Mitigation: Regular steering group meetings and Project Governance according to Prince 2 methodology.

Project summary	SMART Indicators	Means of verification	Important Assumptions
			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 Number of 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).		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 information about the project and potential benefits to them. Providing access to the resources

Project summary	SMART Indicators	Means of verification	Important Assumptions
	1.2 Number of records held in database increased year on year, 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)		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 Number of plant pathogenic taxa affecting endemic tree species and agricultural crops identified. By Y3, Q3. (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 identified pathogens quantified using a combination of disease severity and potential dispersal pathways by Y3Q3. 2.3 The number of pathogenic taxa (and vectors) quantified and the impact (estimated yield loss) assessed for economically important crops (including forestry) by Y3Q3. (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) 2.4 The number of pathogenic taxa quantified and an assessment made of the potential impact of entomopathogenic fungi (EPF) present	2.1 & 2.2 Preliminary observations and findings described in Y1 and Y2 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 Y2Q4. 2.3 Preliminary findings and observations described in Y1 and Y2 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
	on St Helena produced by Y3Q3. (For the first time EPF will be identified to species level and linked to their hosts on St Helena. In this context impact indicators are number and frequency of observed pathogen-host combinations (e.g. invasive pathogen on endemic invertebrate)).		
3. Action plan to mitigate priority identified threats developed with and made available to all stakeholders.	3.1 Change in management practices for at least 4 priority threats to cloud forest species and/or economically important crops. by Y3Q2.	3.1 Action plans published and disseminated to stakeholders by Y3Q2. 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.) trained in the diagnosis of diseases and best practice for effective control	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 ENRD 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. 4.4 Number of records and information about known pathogens of St Helena available online by the end of the project.	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 The new treatment practice(s) demonstrates a measurable impact - 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.

Annex 3: Standard Indicators

Table 1 Project Standard Indicators

DPLUS Indicator number	Name of indicator using original wording	Name of Indicator after adjusting wording to align with DPLUS Standard Indicators	Units	Disaggregation	Year 1 Total	Year 2 Total	Year 3 Total	Total to date	Total planned during the project
DPLUS-A01	People who attended training on plant pathogen diagnostics	Number of extension staff and growers who attended training at Scotland in 2022	People	7 male; 6 female		13		13	at least 6
DPLUS-A02	People who attended training on plant pathogen diagnostics	Number of forestry and conservation workers and officers who attended training at the Kingshurst community centre in 2022	People	20 male; 5 female		25		25	at least 30
DPLUS-A03	People who attended training on plant pathogen diagnostics	Number of growers who attended training at Shape, Sandy Bay in 2022	People	6 male; 3 female		9		9	
DPLUS-A0	People who attended training on plant pathogen diagnostics	Number of pupils who attended training at Prince Andrews School in 2022	People			8		8	

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?	Yes
Is the report less than 10MB? If so, please email to BCF-Reports@niras.com putting the project number in the Subject line.	Yes
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.	No
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.	Yes
Do you have hard copies of material you need to submit with the report? If so, please make this clear in the covering email and ensure all material is marked with the project number. However, we would expect that most material will now be electronic.	No
If you are submitting photos for publicity purposes, do these meet the outlined requirements (see section 15)?	n.a.
Have you involved your partners in preparation of the report and named the main contributors	Yes
Have you completed the Project Expenditure table fully?	Yes
Do not include claim forms or other communications with this report.	