Darwin Plus:
Overseas Territories Environment and Climate Fund
Annual Report

To be completed with reference to the "Project Reporting Information Note" (https://dplus.darwininitiative.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 2022

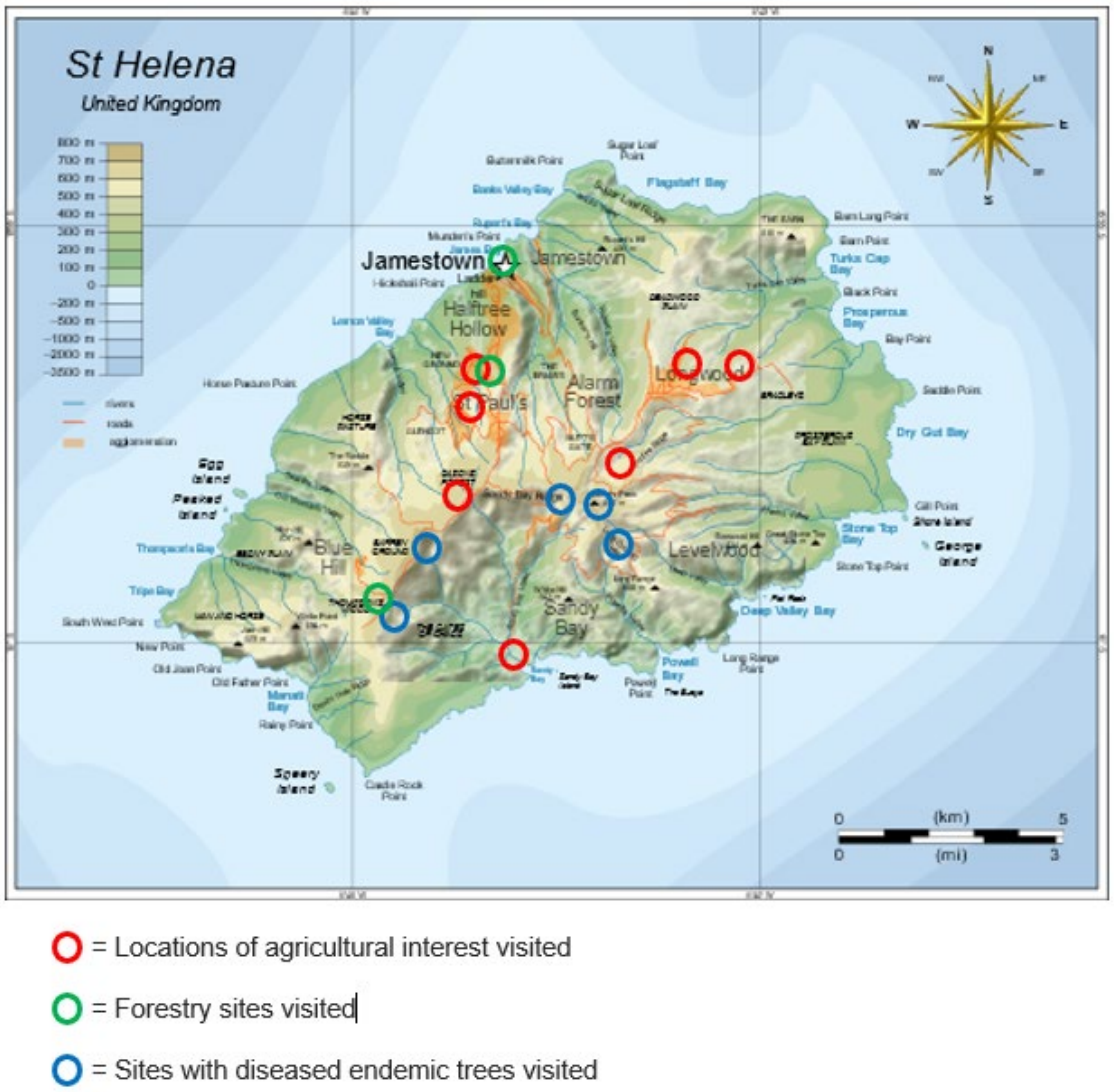
Darwin Plus Project Information

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 2021-Mar 2022) and number (e.g. Annual Report 1, 2)	September 2021 – March 2022; Annual report 1
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, Amy Webster with contributions from SHRI and ENRD; 30 April 2022

1. Project summary

St Helena's endemic trees, insects and crops are threatened by unidentified introduced pathogens, and/or changes to endemic pathogens through climate change. This project will survey and identify pathogens associated with tree death (including nursery stock), declining crop yields and insect populations. Methods developed through CABI's Plantwise initiative, will build capacity in diagnostics and management across all sectors, supporting growers, conservationists, and foresters. Identification of pathogens threatening insects and keystone cloud forest species is the first step to understanding and reversing the decline of the endemic ecosystem and reducing the threat of extinction of St Helena's unique flora and fauna.

Surveys of the pathogens impacting and agriculture will allow for a better understanding of the threats to food security and facilitate the development of agriculture practices that preserve biodiversity and are more resilient to climate change, thus reducing the necessity to import food. 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



= Locations of agricultural interest visited

= Forestry sites visited

= Sites with diseased endemic trees visited

Map of St Helena showing the field sites visited by the project team in February/March 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 and coordination of the teams on St Helena by Rebecca Cairns-Wicks. The main communication channel is quarterly videoconferences for the Project Management (Steering Group). Each partner has representation on group which is designed to support and provide oversight of the project, to review progress, consider problems and develop solutions, and monitor and evaluate project outputs and outcomes.

During October 2021 most of the capital equipment and consumables for the laboratory were purchased. During this period there was constant dialog with SHRI and ENRD over the equipment needed and resources already available. The equipment was shipped to St Helena arriving in time for the first team visit. This enabled a joint set up of the laboratory facilities by the team and training in the use of the equipment during the first visit.

Face to face collaboration on St Helena was initially limited due to the need for a 10-day quarantining period but worked very well in the second part of the visit. The teams on St Helena had meticulously planned the project team's visit in advance with logistics and planning covered by SHRI and preparation and refurbishment of the new lab lead by ENRD. Once joint working commenced after the termination of the quarantine period, all project partners took part in various field surveys including SHRI and the plant protection, forestry and biosecurity sections of ENRD.

Project team members during a first ‘meet and greet’ gathering on St Helena.

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. During the visit collaboration between these projects started and it is envisaged this will further develop in the coming months.

In addition, the team collaborates with the Great Britain invasive non-native species strategy (GBNNSS) who are currently coordinating activities on St Helena for the training of 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 and during the field site visits discussions with numerous growers took place to identify the main disease problems from a grower’s perspective.

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

[redacted] and [redacted] from BiFoR with team members of the cloud forest project.

3. Project progress

3.1 Progress in carrying out project Activities

Planning for the first team visit to St Helena began right at the start of the project and took place on the 21st October. BiFOR team (Prof. Rob Jackson and PhD student Amy Webster visited CABI and a zoom call was made to colleagues in St Helena). Flights and accommodation were arranged for the earliest possible opportunity to visit; the period 14th February to 9th March. This was later than originally intended due to significant flight restrictions being in place.

0.1 Project acceptance, Project setup

The grant offer letter from Darwin was sent on 16th September 2021 and activities could only start in early October, which is a whole quarter delayed compared with the proposed start of 1st of July 2021 in the submitted proposal. The project involves extensive surveys of plant pathogens and insect vectors, much of which can only be conducted during specific times of the year in order to address the seasonality of the target organisms. This makes it very difficult to cover all planned activities over a shorter time frame and effectively, the project had lost the opportunity to undertake a survey during early summer on the island. This will need to happen in the second financial year, which will generate a knock-on effect on the other planned activities. To address the implications caused by the delayed start of the project, the project team asked for a cost neutral extension of the project until the end of the last financial project year (31st March 2025) through a change request, which was granted in January 2022.

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

The first project video conference was held 21st October 2021 using Zoom followed by a second meeting 26th January 2022. The teams from St Helena (SHRI, ENRD), CABI and BiFoR took part in both meetings. During the meetings the agenda points were covered as detailed in in the notes in annex 3.3.

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

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.

Surprisingly little data is available through public information resources regarding existing records of plant pathogens on St Helena and almost nothing regarding pathways and impact. Some records are available through the digitised fungal records from the old 'International Mycological Institute' (IMI) and a few additional ones were uncovered during 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 project database now established and attached as annex 4. 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 in the form of advisory leaflets on pests and in some cases diseases. Moreover, this information was not directly related to incidence in the field and the information was generally found too nonspecific (e.g. blight on tomato) and therefore of not much use in establishing the database of disease records. The database will remain open to include other records should they be uncovered during the duration of the project.

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.

A first draft of the database including the results from the literature search and records collected during the first visit is attached as annex 4 to this report. This is not the final design of the database and modifications to the structure will be made as the programme progresses. Because the visit took place very close to the end of the first project year, the majority of microbial samples collected during the visit are not yet fully processed nor entered into the database as named organisms.

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

Due to the delayed start of the project February/March was the earliest a project team visit could be arranged to St Helena. This time of the year is not optimum for pathogen surveys as it is the end of the dry summer season and fewer crops are still being cultivated. The primarily purpose of the visit was to gain a better understanding of the problems, both regarding food security and tree dieback that would allow for fine-tuning of activities for the remainder of the project. Nonetheless, the chance was taken for extensive surveys, both of the cloud forest, to review the status of the tree dieback, and also to survey as many crops under cultivation as possible.

Several visits to the cloud forests (The Peaks, High Peak, Peak dale) allowed a first assessment of endemic trees (Black cabbage, He cabbage, She cabbage, Whitewood, Dogwood, Gumwood, Redwood, Ebony) for signs of plant pathogens. Diseases symptoms where found on Black cabbage, He cabbage and Whitewood and a range of other endemic plant species, samples (including soil samples) were taken for further assessment. The species with most severe symptoms were Black cabbage and Whitewood and both species show an alarming level of decline.

An additional funding source for the wider project was the St Helena research institute. A grant was awarded to Amy Webster to help with costs of molecular work following a short report she prepared on the symptoms seen on the endemic trees and suggestions of potential causes. Amy's tree health assessments included percentage dieback, leaf wilt, leaf colouring and leaf drop. From this data, relationships between age, size and deterioration have been hypothesised and ongoing monthly recordings of tree health will be carried out by Dr Cairns-Wicks and a member of the cloud forest team, allowing the progression of disease to be tracked over time.

Assessing tree dieback at Diana's peak, St Helena; February 2022.

Diseased Black cabbage tree branch demonstrating infection from the tip.

Diseased Black cabbage tree at Diana's peak, February 2022.

2.1.3 Processing of samples and development of assessment report

Samples (leaves, stems and roots) have been taken by CABI pathologists and the BiFoR team from all endemic tree species showing signs of disease. Soil samples were also taken from the vicinity of some of the diseased trees for analysis. Initial isolations of pathogens from leaf, branch and trunk tissues were undertaken at the newly refurbished ENRD lab at Scotland on St Helena.

Agar plates containing these samples, plus plant and soil samples collected towards the end of the surveys were transported under Defra licence back to the CABI facilities at Egham UK, where further processing continues. At the time of writing isolations from plant samples and identifications of plated pathogens are ongoing. In addition, to direct isolations from diseased plant parts, baiting of oomycete pathogens (*Phytophthora, Pythium*) from soil samples taken close to diseased Black cabbage trees has been set up at Egham. This method uses young leaf tissue of Black cabbage as 'bait' for the motile zoospores of oomycetes which can 'swim' towards and infect the leaf pieces. Isolations are then made from infected leaves onto oomycete selective media that inhibits the growth of most true fungi and bacteria. Two *Pythium* spp (tentatively identified as *Pythium lutarium* and *Pythium diclinum*) were isolated from soils associated with a Black cabbage tree displaying leaf loss in the Dell, high peaks and *Phytophthora kelmanii* from bark shavings taken from a recently deceased whitewood tree near the Peaks nursery.

In addition, to the work isolating pathogens, an assembly of the peaks microbiome is being created using DNA extracted from soil, leaf and stem samples following amplicon sequencing via the minION. Material from the Black cabbage, He cabbage, She cabbage, Whitewood and Dogwood, are being investigated to provide an overview of the microbial species associated with these endemic trees.

Fungi from St Helena being cultured at the laboratory at CABI

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

Crops

Despite the 10-day quarantine period, it was possible to start the survey of crop pathogens immediately on arrival because the quarantine accommodation included access to a small garden. The few crops present were extensively investigated but only a handful of diseases were observed. Amongst the crops sampled were peach, taro, banana, lemon, cabbage, apple, avocado, nasturtium and canna.

Parasitic algae (*Cephaleuros* sp.) on lemon (*Citrus limon*) at Teutonic Hall, February 2022.

Taro ghost leaf spot caused by *Cladosporium colocasiae* on *Colocasia esculenta* at Teutonic Hall, February 2022.

The identification of plant pathogens by symptoms alone is possible in some cases where the symptoms are either unique and or extremely characteristic. In many other cases it is possible to make an educated guess, but laboratory confirmation is required. As the plant pathogens of St Helena have previously received very little attention the team were cautious about making diagnoses on symptoms alone.

The topography of St Helena is such that there are very few areas of flat land suitable for crop production and much of the crop production is undertaken in what could be considered gardens and allotments. With the exception of the coffee plantations the area of any one crop in a location was measured in square metres, the maximum was approximately 100 sq metres. The team were escorted to the major production and trial areas at Plantation Square, Longwood, Bottom Woods, Scotland, Sandy Bay and Clifford Arboretum by local staff. Crops assessed included potato, sweet corn, aubergine, carrot, banana, coffee, green bean, grapes, melon, plum, orange and onion.

There were a number of plant pathogens found on St Helena crops. Fruit tree diseases included: peach rust (*Tranzchelia discolour)* , peach powdery mildew (*Podosphaera spp)*, peach leaf curl (*Taphrina deformans*), plum rust (*Tranzchelia pruni-spinosae*), apricot powdery mildew (*Podosphaera tridactyla, Sphaerotheca pannosa*), apple frogeye spot (*Diplodia seriata*), bacterial canker on peaches (*Pseudomonas syringae*), mango powdery mildew (*Oidium mangiferee*), peach shot hole disease (*Wilsonomyces carpophilus*.) and banana cordana leaf spot (*Neocordana musae or Neocordana johnstonii*). Vegetables diseases: cucumber powdery mildew (*Podosphaera xanthii*), northern leafspot on sweet corn (*Exserohilum turcicum*), bean ascochyta (*Ascochyta fabae*), potato early blight (*Alternaria solani*), Unknown potato leaf spots, bacterial wilt of pepper (*Ralstonia solanacearum*). In the invasives/flowers: wild mango powdery mildew, leaf spot on New Zealand Flax, leaf spots on white weed, virus on nasturtium, leafspots on fern, white rust on wild radish.

Coffee plantation at Sandy Bay.

Forestry

Diseased forestry trees, mainly silky oak (*Grevillea robusta*) and maritime pine (*Pinus pinaster*), were assessed at Jamestown (moat), Plantation and Thompson's wood. Here the biggest concern stems from a recently introduced wood boring insects (the woodwasp *Sirex noctilio* and the false powderpost beetle *Xylopsocus capucinus*), which in the case of *Sirex* act as vectors of fungal diseases (*Amylostereum* sp.) Both *X. capucinus* and *S. noctilio* tend to attack already weakened trees. This observation may offer opportunities to suppress dieback in pine afforestations through better forest management by improving overall health of trees. However, the impact caused by other damaging tree pests such as termites may weaken trees sufficiently to allow the newly arrived pests to thrive.

Silky oak showing resinous gum on trunk

Exit holes revealed on trunk after the removal of the resinous gum

In addition to insect attack it would appear that the silky oak trees in Jamestown moat have an additional problem. Several fungi known to be pathogens of trees have been isolated from samples sent previously to CABI-Egham for analysis. Current investigations are ongoing but these fungi have been tentatively identified as *Bisifusarium delphinoides, Gibberelulopsis nigrescens, Xenoacremonium sp,* and *Neofusicoccum parvum/ribis* species complex The

relationship between the fungi and the decline of the tree has not yet been established but it possible that one or more of them is vectored by *X. capucinus*. When on site it was noted that some silky oaks were suffering from termite damage, which may have weakened the trees sufficiently to allow entry of *X. capucinus*.

The team also visited pine trees near Plantation Square. These appeared to be showing dieback inasmuch that the needles on the lower branches were turning brown. These trees also had insect exit holes in the trunks which could be assigned to the woodwasp *S. noctilio*. Some of the trees had been killed and toppled over. Fungus was seen growing through the bark in some places on standing and dead fallen trees. The fungal stroma was creamy white and clearly a Basidiomycete of some sort. *Amylostereum* sp is a known pathogen that is vectored by wood wasps and it would appear that this is taking place in St Helena. The basidiomycete stroma was taken to CABI and is currently being cultured and molecular methods will be used to confirm the identity.

Basidiomycete (probably A*mylostereum* sp) fungus growing through the bark of a dead tree near plantation. The trees were affected by *S. noctilio*.

Silky oak stump in Jamestown, St Helena, showing termite infestation.

Entomopathogenic fungi (EPF)

As the timing of the first visit was not deemed well suited for a pathogen survey, the first visit by an entomopathogenic fungus (EPF) specialist has been delayed until the second half of 2022. However, a number of EPF could were collected and await identification. Of these the most interesting are:

- A *Hirsutella* sp. on an introduced *Empoasca* leafhopper feeding on the invasive Whiteweed (*Austroeupatorium inulifolium*)
- An unidentified possibly endemic EPF on the endemic leafhopper *Sanctahelenia decellei* on Gumwood (*Commidendrum robustum*)
- An unidentified possibly endemic *Aschersonia* on a possibly endemic unidentified whitefly on Whitewood (*Petrobium arboretum*)
- *Beauveria* sp. on a cabbage looper caterpillar
- Unidentified EPF on introduced scale insect (Coccidae) on Whitewood (*Petrobium arboretum*)
- Unidentified EPF on a spider

A dead ladybird beetle (*Cheilomenes lunata*) initially suspected to have succumbed to an EPF turned out to be the host of a braconid wasps (*Dinocampus coccinaellae*), which is a new record for this species on St Helena.

Leafhopper (*Empoasca* sp.) infected by unidentified *Hirsutella* species.

Unidentified *Aschersonia* species on an unidentified whitefly on Whitewood.

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 too early in the project to make any judgments on treatments and best practice procedures these can only be developed based on knowledge of the pathogens identified through surveys and pathogenicity experiments. In the log frame the action plan is not due to be finalised until the end of year 2 and will involve a participatory approach documented through meeting protocols with stakeholders.

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

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. Purchasing and shipping of equipment began before the first joint video meeting. During the meeting the purchase of further items were discussed and shipped by December 2021. A list of purchased items is provided in annex 5. Release from customs on St Helena took some time but happened in time for the first project team visit starting on 15th February. Before the team visit, the ENRD team had the new lab cleared, new furniture installed and setup some of the larger equipment such as the laminar flow cabinet.

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 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 camera with high-quality close-up function), and these items were purchased on return to the UK and currently await shipment to St Helena.

[redacted] assessing diseased Black cabbage tree branch in new ENRD lab at Scotland, St Helena.

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

Joint unpacking of the remaining equipment was done as soon as the CABI and BiFoR team was released from quarantine, followed by a number of training sessions on how to use the newly installed equipment. Jointly collected samples of diseased plants were used to provide on the job training aimed at building capacity to independently process samples in the future. Training 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. It was therefore decided to delay the online diagnostics course (including training tests) to the next visit later in 2022.

3.2 Progress towards project Outputs

Outputs:

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

Existing literature and other knowledge sources have been systematically reviewed for records of plant pathogens from St Helena as a result 40 records were identified. 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 a number of agriculture plant pathogens have been already identified during first surveys (database in annex 4). However far more plant pathogens will be added once the isolation and identification of the agricultural plant material taken from St Helena is complete. Similarly, samples have been taken from diseased forestry and endemic trees and pathogens (and saprobes) await identification. In addition, the molecular processing of samples through BiFoR has started using samples collected during the first visit as planned. The database will add considerably to the knowledge of pathogens on the island and their potential modes of transmission, the work is on track to deliver a database by the end of the project. The database is seen as a living document that can be added to as more discoveries are made and documented beyond the project implementation period.

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

Good initial progress was made towards assessing the impact of pathogens on the peaks cloud forest species and economically important crops. However, as this is just the start of the project it is difficult to make any firm statements about the impact of pathogens which will only be possible once the surveys are completed. Pathogens and their economic impact are not well documented in St Helena, so the project is starting from a baseline of very little documented knowledge.

Our snap shot survey of the trees of the cloud forest indicated that there were several problems taking place simultaneously. For example, on the Black cabbage trees there were leaf spotting pathogens, tip dieback and total tree dieback. Tree dieback is often the result of complex interactions between individual pathogens and in addition the impact of abiotic factors such as water logging or heat stress. Unravelling these complex interactions will take time and will require several sequential steps of sampling, isolation and re-infecting of seedlings to confirm the causative agent(s). Some of the initial isolations have already revealed pathogenic genera associated with diseased trees, notably *Pythium* and *Phytophthora* spp. In this regard the first visit was more successful than initially anticipated, however the association of a microorganism with a disease does not prove causality, this can only be achieved through pathogenicity testing which is to be conducted by the PhD student Amy Webster (see activities).

Black cabbage tree symptoms

Leaf spots

Tip dieback

Total dieback

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.

A first visit can only cover a snapshot of the situation regarding crop diseases. However, a number of major crop pathogens have already been identified, demonstrating a negative impact on yields, but this will be expanded on during further field sites visits. A ranking of importance of individual diseases is not possible at this stage.

The research is currently 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.*

The first 6 months of the project included the first field site visit including the collection of samples, the installation of a pathology lab and initial laboratory training of local staff for the identification of plant pathogens. Currently, activities are going to plan and the outcome is fully on track to be delivered. Local capacity to manage insect pests and plant pathogens has already increased through advice on chemical use and phytosanitation. It is, however, too early to provide evidence for a full delivery of the outcome at this stage.

3.4 Monitoring of assumptions

The start of the project was delayed and this first annual report only covers the first 6 month of the project. Implications caused by the delayed start had been addressed by a change request, which was approved by the DI. This did not require to change risks and

assumptions as such and could be addressed through an updated activity planner and small changes mostly referring to slightly adjusted 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. Therefore, key informant interviews will need to be conducted with growers in order to get baseline data for comparison.

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. St Helena has strict quarantine laws and to date there have been no cases identified on the island. 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.

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 intends to ensure that activities including any training are flexible to accommodate the other 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 regular steering group 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 St Helena Research Council

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

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

Assumption 8: Access to the infected parts of the infected trees are easily possible. This has not been an issue, 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.

Assumption 9: Local farmers willing and keen to engage and share their local knowledge. Share information about the project and potential benefits to them.
Providing access to the resources produced as a result of the project. No change to this required.

Assumption 10: Timing of travel to and from St Helena not disrupted by COVID 19 or adverse weather conditions. The requirement for 10 days quarantine on arrival in St Helena limits what is possible during any particular visit. During the first visit we attempted to maximise our available time by surveying pathogens that were present in the garden (accessible during lockdown) and requesting samples to be brought to the property for diagnosis. It is hoped that in the future the quarantine period will be reduced. In order to mitigate issues, in each financial year as much flexibility as practical in timing of activities will be employed so that the project can accommodate flight delays and quarantine requirements.

Assumption 11 Standard diagnostic procedures do not allow the measurement of current spread of pathogens. The project will draw on external specialist advice in the case of where unusual methods have to be employed.

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 too early in the project to know what treatments or best practices will need to be developed

Assumption 13 Timely availability of facilities to hold workshop on St Helena. Stakeholders are keen and available to engage. There has only been one stakeholder meeting on the island and this was a presentation of the aims of the project and initial findings. The presentation was hosted at the ENRD facility and was open to all staff on site.

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. With a least a proportion of the plant pathogens on St Helena likely to belong to non-indigenous invasive taxa and their impact likely to become more prevalent with a changing climate this project supports the future proofing of St Helena against increased risks caused by pathogens through the development of management procedures helping to increase prevention of introduction and establishment of further pathogens and the mitigation of the impact of pathogens already present on St Helena.

As the project has only just has started none of the anticipated beneficial impacts on biodiversity and poverty alleviation have been achieved at this stage. However, some significant foundations have been laid towards achieving these impacts:

- First steps towards identifying the diseases complex most likely underlying the dieback of several endemic tree species have been taken.
- Identification of a number of important crop diseases lays the foundation for improved crop management leading to poverty alleviation
- Initial training has already contributed to a better capacity to deal with plant pathogens

5. OPTIONAL: Consideration of gender equality issues

During the first 6 month no specific gender equality issues had to be addressed. However, all activities were in line with the outline provided in the proposal

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 this annual project report). 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 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 the use of 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. I would have been beneficial to have visited the laboratory prior to having made the purchase of equipment to see exactly what the facilities were. Unfortunately, the long shipping times and need to get equipment in place prior to the first visit did not allow for this.

The good and intensive collaboration with research teams from other projects working on similar subjects on St Helena (DPLUS104 'Conserving St Helena's endemic invertebrates through invasive invertebrate control' and the FCDO (CSSF) funded Cloud Forest Project 'Restoring St Helena's Internationally Important Cloud Forest for Wildlife, Water Security') has already led to very useful synergistic activities and are anticipated to benefit outcomes and lead to improvements of the individual projects.

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

Not applicable at this stage.

9. 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.

10. Sustainability and legacy

The profile of the project has been promoted at several levels. Locally, through public announcement of the arrival of a visiting team of scientists before the start of the project team visit, a radio interview 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 once the results of the first visit have been processed. 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 and plans have been made to provide training and experimental growth plots so as to whet the appetites of the students with regard a career in agriculture or agricultural extension.

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.'

11. Darwin 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 were always 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/) and a recent newspaper article about the project has been drafted.

12. Impact of COVID-19 on project delivery

Covid-19 has impacted the project work plan significantly with an initial delay of 3 months to the project start date. As a result, we have extended the project by a year in a cost neutral way through a change request, which was granted in January 2022. This allows a more flexible approach regarding the planning of field site visits to St Helena.

Due to the fact that there are no cases of Covid in the community on St Helena health and safety of both the visiting team and the wider public was assured through quarantine measures. However forward planning turned the 10-day quarantine period in February 2022 into a productive period (accommodation with access to a limited number of crops, setup of makeshift lab facilities, provision with field samples by St Helena team). Nonetheless, such a long quarantining period is never as productive as time spend together with the whole team in the field and the resulting longer than average stay on the island has required a very tight budgeting.

Despite ongoing Covid restrictions, we have managed to make good progress towards the project outputs, and have almost caught up in our activity plan despite the delayed start. We do not expect any longer-term delays caused by Covid during the remainder of the project, but short-term re-planning and financial restriction on the travel budget may occur in case a visiting scientist tests positive shortly before departure.

Makeshift lab at Teutonic Hall during quarantining

13. Safeguarding

Please tick this box if any safeguarding violations have occurred during this financial year. ☐

If you have ticked the box, please ensure these are reported to ODA.safeguarding@defra.gov.uk as indicated in the T&Cs.

There have been no updates to the lead organisation's policies or procedures as detailed in the project proposal

14. Project expenditure

Table 1: Project expenditure during the reporting period (1 April 2020 – 31 March 2021)

Project spend (indicative) in this financial year	2020/21 D+ Grant (£)	2020/21 Total actua D+ Cost (£)	Variance %	Comments (please explain significant variances)
Staff costs	[redacted]		[redacted]	
Consultancy costs				
Overhead Costs	[redacted]		[redacted]	
Travel and subsistence	[redacted]		[redacted]	
Operating Costs	[redacted]		[redacted]	Only high variance because of low number
Capital items (includin smaller pieces o equipment)	[redacted]		[redacted]	
Others (Lab consumables shipments, PPE)	[redacted]		[redacted]	
TOTAL	[redacted]			

Annex 3 Onwards – supplementary material (optional but encouraged as evidence of project achievement)

The following documents are provided as additional annexes separately to this document:

Annex 3.1	Agenda first project team meeting
Annex 3.2	Notes first project team meeting
Annex 3.3	Agenda second project team meeting
Annex 3.4	Notes second project team meeting
Annex 4	Pathogen database
Annex 5	List of purchased equipment

Checklist for submission

	Check
Is the report less than 10MB? If so, please email to Darwin-Projects@ltsi.co.uk putting the project number in the Subject line.	Y
Is your report more than 10MB? If so, please discuss with Darwin-Projects@ltsi.co.uk about the best way to deliver the report, putting the project number in the Subject line.	
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.	Y
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.	N
Have you involved your partners in preparation of the report and named the main contributors	Y
Have you completed the Project Expenditure table fully?	Y
Do not include claim forms or other communications with this report.	