



Department  
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## Darwin Plus: Overseas Territories Environment and Climate Fund - Final Report

**Important note** - to be completed with reference to the Reporting Guidance Notes for Project Leaders: it is expected that this report will be a maximum of 20 pages in length, excluding annexes

### Darwin Project Information

Project Ref Number	DPLUS016
Project Title	Caicos pine forests: mitigation for climate change and invasive species
Territory(ies)	Turks and Caicos Islands
Contract Holder Institution	Royal Botanic Gardens Kew
Partner Institutions	Department of Environment and Maritime Affairs (DEMA)
Grant Value	£199,693
Start/end date of project	April 2014 to March 2016
Project Leader	Martin Hamilton
Project website	<a href="http://www.kew.org/science-conservation/research-data/science-directory/projects/turks-and-caicos-islands-pine-recovery">http://www.kew.org/science-conservation/research-data/science-directory/projects/turks-and-caicos-islands-pine-recovery</a>
Report author and date	Martin Hamilton and Michele Sanchez, 24 May 2016

**PLEASE NOTE:** Supporting documents referred to in this report as Annexes have been uploaded to an FTP site as a single zip file that can be downloaded from [here](#). Individual links are also provided in the Annex sections at the end of this document.

## 1 Project Overview

The Turks and Caicos Islands (TCI) are home to the Caicos pine (*Pinus caribaea* var. *bahamensis*) and one of the UK Overseas Territories located in the Caribbean region in the south eastern end of the Lucayan archipelago (TCI and The Bahamas) (Figure 1). The Caicos pine is the National Tree of TCI and also a foundation species of the Pine Rockland ecosystems which only occur on four islands in the northern Bahamas and three islands (Pine Cay, North Caicos and Middle Caicos) in TCI (Figure 2). The pine forests in TCI are small, i.e. only 13 km<sup>2</sup>, but home to several native/endemic plants and animals and have a rich socio-cultural heritage value (see Annex 7). The TCI are low lying islands (highest point is only 49 m asl!) and sea-level rise will be a major issue in the future.

The Caribbean is one of the world's biodiversity hotspots<sup>1</sup> and 72% of its plants are endemic, i.e. not found anywhere else in the world<sup>2</sup>. There are several threats to the endemic flora and fauna of these islands (e.g. deforestation, illegal trade), but a growing concern are invasive species due to global trade and increased movement of humans and biological material. Kairo *et al.*<sup>3</sup> reported 552 invasive species present in the Caribbean in 2003. TCI is no exception and after the accidental introduction, probably via imported plant material, of the pine tortoise scale insect, *Toumeyella parvicornis*, to the islands around 2005 a severe decline of the pine forests was noticed<sup>4</sup>. After just a decade circa 95% of all mature Caicos pine trees in TCI have been killed by the infestation threatening the species with extinction leading to its assessment as 'Vulnerable' in the [IUCN Red List](#) of threatened species<sup>5</sup>. A large part of pine forest (all age classes of individuals) on North Caicos were killed by an escaped agricultural fire in 2009 during the dry season (see Figure 2), another common and worrying problem in the Caribbean region which contributes to biodiversity loss and the spread of invasive species.



Figure 1: Map showing the Turks and Caicos Islands (TCI) and the pine forests of Caicos pine in the Northern Caribbean region. TCI lies in the south eastern end of the Lucayan archipelago (TCI and The Bahamas).

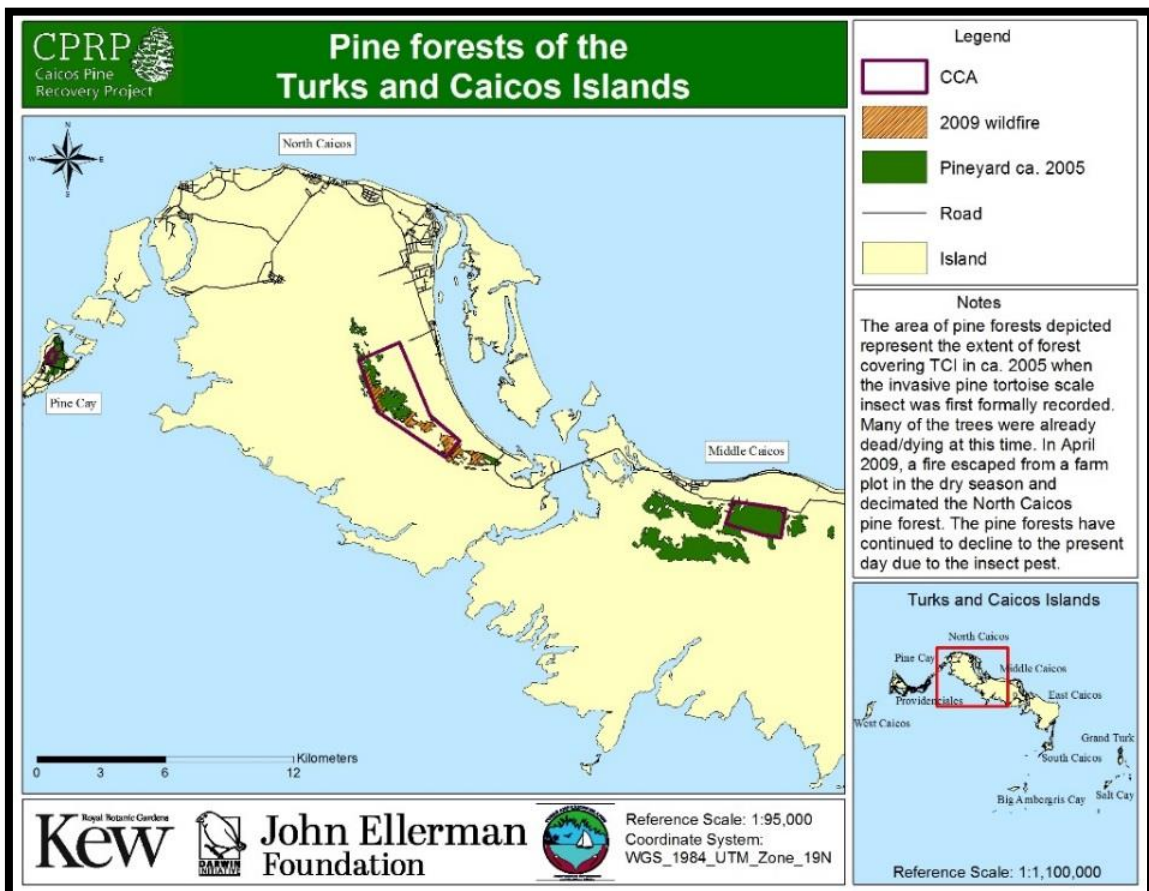


Figure 2. Map of the Turks and Caicos Islands showing location of the Caicos pine forests, also known locally as pine yards, and Core Conservation Areas (CCAs) identified during this project.

The Caicos Pine Recovery Project (CPRP), a partnership established in 2008 between the Royal Botanic Gardens, Kew in the UK and TCI Department of Environment and Maritime Affairs (DEMA<sup>a</sup>), started addressing some of the conservation issues to increase the survival of the species. The team began to document baseline data through *in-situ* monitoring, develop conservation initiatives like the establishment of an *ex-situ* collection and undertake community outreach activities (see Annex 6). However, further scientific knowledge on the Caicos pine and the pine forests was needed to be able to develop a long-term strategy for the conservation of Caicos pine and restoration of the pine forests in TCI. There was also need to increase the size and genetic representativeness of the *ex-situ* collections, as those were not representative of the diversity in the wild populations. The constant and high mortality of mature trees in the wild by the invasive scale insect required immediate action to rescue this diversity before it was lost. It is known that genetic diversity of a species can be an important factor in adaptation to climatic changes and reproductive fitness to ensure natural regeneration. It was also important to try to detect signs of resilience to the scale insect by individual pine trees as there is currently no effective methods of control for this pest in the wild; identify mycorrhizal associations which are essential to establishment of trees *in-* and *ex-situ* and play an important role in the uptake of fresh water by pines; investigate the relation between water stressed pines and pests as fresh water will tend to become scarcer with climate change and the population viability levels and reproductive potential to guide restoration efforts. The team were also missing information on which sites would be best for restoration and conservation efforts in terms of viability and resilience to the predicted future sea-level rise and severe droughts. Sea-level rise in these low lying islands will also affect coastal populations and drive the movement of urban areas to inland locations threatening existing forests.

The 'Caicos pine forests: mitigation for climate change and invasive species' project (DPLUS016) was designed to address the issues mentioned above to fill the knowledge gaps about the Caicos pine and the pine forest ecosystem, improve the *ex-situ* collections of the species, build local capacity to conserve and restore the pine forests, increase outreach to facilitate the future implementation of the strategy and raise awareness on the importance biodiversity and conservation. Scientific research delivered by Kew's experts was focused on answering specific questions about genetic diversity, mycorrhizal associations, seed longevity, chemical resilience to pests, effects of water stress, pine ecology and population viability. DEMA lead on improving the *ex-situ* collections using seed collections from the wild and propagation of Caicos pines in the local CPRP nursery, assisted by Kew's horticulturists. Local capacity was built via tailored training during field visits. Community engagement and wide dissemination of information were also an important element of the project delivered in partnership by Kew and DEMA. All these elements came together to deliver protocols (see Annex 5) and a 'Restoration Strategy' (see Annex 6) based on the scientific evidence gathered (see Annex 4) and practical experience gained throughout the CPRP partnership. These documents, written in partnership with DEMA, will enable the TCI Government to implement the 'Restoration Strategy' for the Caicos pine forests, avoiding extinction and genetic depauperation of the Caicos pine and securing the pine forests in TCI for future generations.

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<sup>a</sup> In April 2016 DEMA was changed to DECR- Department of Environment and Coastal Resources

## 2 Project Achievements

### 2.1 Outcome

Outcome:	A 'Restoration Strategy' will provide the basis for managing and restoring the Caicos pine forests and building resilience to climate change and invasive species in the future. Implementation of the strategy will be achieved by following a series of complementary and coherent protocols that are developed in concert with local partners to ensure they are practical and implementable. Strengthened capacity and expanded <i>ex-situ</i> collections will ensure that the robust evidence generated through the project will be used by DEMA alongside best practise to successfully deliver long term Caicos Pine conservation.		
	Baseline	Change by 2016	Source of evidence
Indicator 0.1	No strategy to restore or conserve the Caicos pine forests	' <a href="#">Caicos Pine Recovery Project National Tree Restoration Strategy- 2016-2036 restoration strategy to secure the Caicos pine for future generations</a> ' delivered, launched and publically available through open-access.	Annex 6: CPRP National Tree Restoration Strategy (open-access via Research Gate); Publicity (see Figure 3 and <a href="#">social media</a> ).
Indicator 0.2	No information or standards and methodologies available to be able to write and implement a restoration strategy for the Caicos pine forests	Documents underlying the strategy delivered, launched and publically available through open-access. a) ' <a href="#">CPRP Scientific Data and Results- Sampling and analyses undertaken</a> ', b) ' <a href="#">CPRP Protocols- Standards and methodologies to conserve the TCI National Tree</a> ', c) ' <a href="#">CPRP Socio-cultural History Report Results and findings of pine yard interviews with Caicos Islanders</a> '.	Annexes 4, 5 & 7 (open-access via Research Gate); Publicity (see Figure 3 and <a href="#">social media</a> ).
Indicator 0.3	Limited local capacity	Two key DEMA staff have been trained in all activities and methodologies needed to implement the Restoration Strategy	Reports (see Annexes 8-11); Figures 4, 5 and 6 in this document; Field activities posted on <a href="#">social media</a> .
Indicator 0.4	Limited <i>ex-situ</i> collection not representative of wild populations	<i>Ex-situ</i> collection in TCI and at MSB UK have been bulked up and now are genetically representative of the wild populations	Figures 5 and 6 in this document; Document 'a' in indicator 0.2 (Annex 4); Output 2 section 2.3 of this document



The restoration strategy document listed in indicator 0.1 has been agreed with DEMA and was launched (see Annex 11) at the Premier's office in TCI on April 6<sup>th</sup> 2016 (Figure 3) with the presence of TCI's Governor (HE Peter Beckingham), TCI Hon Minister of Tourism, Environment, Heritage and Culture (Porsha Stubbs-Smith), DEMA's director (Dr John Claydon), Department of Agriculture Director (Mrs Wilhelmina Kissoosingh), local press, Project Leader and TCI Project Manager, amongst others. The other three documents listed in indicator 0.2 above, which were the foundation of the strategy, were also agreed with DEMA and launched at the same event. All documents are available electronically in open access via Research Gate.

Document 'a' of indicator 0.2 (Annex 4) includes a detailed account of sampling techniques and methodology used for analysis, results and discussion applied to the project's main scientific questions. This document was used as the foundation for guiding the protocols and strategy and provided the evidence that a restoration strategy can be implemented in TCI as some Caicos pines are showing resilience to the invasive pine tortoise scale insect by different chemical signatures, there is now a genetically representative *ex-situ* collection and Caicos pines share an ectomycorrhizal fungal taxa with *Coccoloba* sp., a common plant throughout the pine yards, which indicates that even in areas where no pines are alive there are good chances of re-introduced pines to survive. The research also gave some insight into the relations between response to water stress expected with climate change and potential for natural regeneration, indicating that active forest management will be needed to maintain the pine forests.



Figure 3. Twitter post showing Project Leader Martin Hamilton in Providenciales TCI in April 2016 with TCI HE Governor and Hon Minister of Tourism, Environment, Heritage and Culture during launch of the Caicos Pine Recovery Project National Tree Restoration Strategy

Standards and methodologies presented in document 'b' of indicator 0.2 (Annex 5) have been tested in the field and adapted to work with local conditions and resources available, being practical and implementable. These 'Protocols' (Annex 5) were based on Kew and DEMA's practical experience successfully growing locally and planting Caicos pine trees in the pine yards in TCI, years of *in-situ* monitoring and management and scientific evidence provided in document 'a' (Annex 4). During this project the *ex-situ* collections have been increased and are now representative of the genetic diversity in the wild and local DEMA staff trained during the project are now able to perform all the activities described in the protocols and collect seed, grow, cultivate and plant out Caicos pine trees, in addition to perform *in-situ* monitoring and management. DEMA staff were able to grow 438 new healthy Caicos pine saplings in the North Caicos Government Farm (NCGF) project nursery in TCI since the project started (Figure 5) and successfully planted out 171 new trees in the restoration plots in Pine Cay (Figure 4).



*Figure 4. CPRP TCI PM B.Naqqi Manco and TCI Nursery Officer Junel Blaise monitoring one of the 98 Caicos pine trees planted before 2014 on Pine Cay (left). During the project 171 new pine saplings were transported by project partner Meridian Club Resort (top right), prepared and planted out on Pine Cay pine yard by DEMA staff and community members*

The project was able to deliver in a two-year window applied scientific knowledge, detailed protocols and restoration strategy along with full training of local capacity enabling TCI government to rescue their National Tree from local extinction and conserve the Caicos pine forests for future generations. This was possible through the wide range of expertise available at Kew and long partnership with DEMA enabling enough practical experience on TCI pine yard ecosystem before and during the project. These elements along with crucial funds received by Darwin Initiative through this project resulted in successful delivery of outputs on time and great value for money.

## **2.2 Long-term strategic outcome(s)**

Some long-term strategic outcomes resulted from the project. The TCI Department of Education Director (Mr. Edgar Howell) personally requested publications available on the Caicos pine for the school's libraries (sent by the Project Co-Ordinator) and indicated interest in adding the Caicos pine to the National curriculum, after his visit to the Caicos Pine Yard Trail during its pre-launch in May 2015. DEMA's outreach officer and TCI Dept. of Education are currently liaising on this matter.

Awareness about invasive species and their risks to local biodiversity has been increase in TCI. A full-time Plant Health Inspector has been hired and is based in Providenciales, and the former plant health inspector has been made Chief Plant Health Officer. However, there has been no new changes to the Plant Health & Quarantine policy and ordinance.

The creation of a new category of Protected Areas called Critical Habitat Reserves has been proposed in the revision of the National Parks Ordinance, allowing for creation of Protected Areas by virtue of their conservation value. The recommendation carried forward to Cabinet included Pine Woodlands as one of the key habitats for conservation. Critical Habitat Reserves will be subject to environmental impact assessments for all development and a policy of "no net loss" of habitat value will be implemented. All pine yard habitat (including former pine yard habitat) was recommended for inclusion in this new category and there was also a recommendation made to change the policy of absolute prohibition against lighting fires within Protected Areas to allow for approved controlled burning where needed to enable pine forest management. This recommendation resulted from efforts and data provided by DEMA and Kew through the project.

During the project the TCI Governor, Minister of Tourism, Environment, Heritage and Culture and Department Directors have become aware of the importance of the conservation of the Caicos pine forests and have pledged support to the implementation of the Restoration Strategy (indicator 0.1), as well as other stakeholders (land owners like Meridian Club) and the private sector (e.g. Big Blue).

## 2.3 Outputs

Output 1: Scientific basis for Caicos pine restoration established				
Indicator	Baseline	Change recorded by 2016	Evidence	Comments
Indicator 1a Habitat modelling	No models exist	Captured TCI pine yard imagery for all islands using UAV (drone). Core Conservation Areas (CCAs) identified & mapped (Figure 2).	Annex 5 (indicator 0.2 'b') & Annex 4 (indicator 0.2 'a').	Further imagery processing necessary. See below.
Indicator 1b Genetics	<i>Ex-situ</i> collections not representative; limited data available for wild, adult trees	442 DNA samples from <i>ex-situ</i> nursery collections, seed orchard & wild populations genotyped. Loss of rare alleles in wild shows importance of maintaining a representative <i>ex-situ</i> collection & targeted seed collection.	List of genotypes of the <i>ex-situ</i> collection and results in Annex 4 (indicator 0.2 document 'a').	
Indicator 1c Chemical compounds	No chemical data available	79 samples analysed, revealing 9 compounds being 3 of those ( $\alpha$ -pinene, $\beta$ -pinene and $\beta$ -phellandrene) indicative of tree health and location.	List of chemical compounds and results in Annex 4 (indicator 0.2 document 'a').	
Indicator 1d Mycological associations	No existing mycorrhizal fungi species list for Caicos pine associations	873 extractions analysed revealed 18 ectomycorrhizal fungal taxa (ECM) belonging to 10 families in pine yards; one shared with <i>Coccoloba</i> sp.	List of ECM and results in Annex 4 (indicator 0.2 document 'a').	
Indicator 1e Population assessment	No existing assessment	Ecological data gathered/analysed from 84 trees in the wild and Population Viability Analysis (PVA) done	Assessment and PVA in Annex 4 (indicator 0.2 document 'a').	
Output 2: <i>Ex-situ</i> collections strengthened to support conservation and restoration				
Indicator 2a Allelic richness	Limited genetic diversity in <i>ex-situ</i> collections due to material held only collected in limited locations in TCI	Allelic richness increased from 3.13 (2010) to 3.7 (2015). <i>Ex-situ</i> collection now representative of extant wild genetic diversity.	Annex 4 (indicator 0.2 document 'a').	
Indicator 2b Seed collections		Seed collections from 2 out of the 3 populations banked at MSB, UK. Number of collections banked increased from 2 to 12.	MSB seed collections banked under Serial N <sup>os</sup> : 870090, 870089, 870078, 870056, 870067, 818067, 818056, 818089, 818078, 818090, 650830 & 650829)	Genetic similarity of Middle (MC) & North Caicos (NC) mean seeds from MC can be used for both.
Indicator 2c		Increased from 366	Nursery stock	

Nursery stock and seed orchard		saplings/trees (March 2014) to 633 (Dec 2015). Seed orchard expanded from 29 trees (May 2014) to 142 trees (Jan 2016)	checked in December 2015 during fieldwork and seed orchard data published in Annex 5 (indicator 0.2 document 'b').	
Output 3: Capacity building to enable DEMA to manage the Caicos pine forests				
Indicator 3a Training	Staff not fully trained	Two key DEMA staff (TCI project manager and Nursery Officer) fully trained and using protocols. Trained staff bulked up the <i>ex-situ</i> collections and started monitoring trees in the wild using protocols.	Figures 4, 5 & 6 (this document); Figures published in Annex 5 (indicator 0.2 document 'b'). Field reports (Annexes 8-11); Publicity through <a href="#">social media</a> . Figure 3	Details in the text below
Indicator 3b Active monitoring	DEMA not currently using protocols to monitor tree health			
Indicator 3c Protocols				
Output 4: Restoration Strategy for local implementation				
Indicator 4a Data collection protocol	a-e) No standards exist	Protocols tested in the field, written and published with feedback and agreement from DEMA.	Published in Annex 5 (indicator 0.2 document 'b'). Restoration Strategy (indicator 0.1) was written in agreement with DEMA, published (see Annex 6) and launched (see Annex 11) in TCI in April 2016 (indicator 0.1).	Publications available online open-access via Research Gate (for links see Annex 2)
Indicator 4b Seed collection protocol				
Indicator 4c Nursery production protocol				
Indicator 4d Restoration Protocol				
Indicator 4e Monitoring protocol for health of wild/reintroduced trees				



During this two-year project five field trips to TCI were carried out by Kew staff (in April/May and November/December each year, plus a final trip for the strategy agreement and launch in March 2016). The field activities always included the participation of DEMA staff, mainly the TCI Project Manager and nursery officer who have been involved in the Caicos Pine Recovery Project for a long time and are key staff to carry out the strategy implementation, enabling training to be delivered to build local capacity, knowledge and information sharing and partner DEMA's involvement and feedback throughout the project. DEMA is now able to manage the Caicos pine forests and run the NCGF project nursery. These two staff (one of them permanent) are now trained in all the methodologies and standards required to execute the protocols, including collecting specimens and data (e.g. herbarium vouchers, DNA samples, fungal fruit bodies, insects), monitoring reproductive pine trees, collecting and processing the seeds (Figure 6), propagating and cultivating Caicos pine trees, planting out trees in the restoration plots and aftercare, monitoring tree health and growth in the permanent and restoration plots and stock checking the nursery and seed orchard (Figure 5). These two DEMA staff are familiar with the CCAs and the pine forest ecosystem and have produced and planted out in the pine yards successfully 171 Caicos pine trees during this project (Figure 4 and Figure 5), being used to manage members of the community during special activities. They have been fully trained in forest management techniques (i.e. prescribed fire, broadleaf clearance, trail maintenance, use of machinery, laying out plots, planting) (Figure 6) and are used to outreach activities with school groups, researchers and community members. Another member of DEMA staff Mrs Amy Avenant, Environment Outreach Coordinator, has been crucial in helping out with outreach during the project.

These field activities were also key for the collection of samples/data for delivering the scientific research and testing methodology/standards and acquiring data to inform the protocols and strategy. All sampling points of scientific collections have been recorded, geo-referenced and added to UKOTs database at Kew and made available to TCI partner DEMA. GIS files and maps were shared with DEMA before the end of the project and are available to partners via cloud storage.

The development of the protocols and the strategy included input from Kew experts and DEMA staff (Figure 6) and all agreed with the final versions delivered at the end of the project. This ensured that these documents are implementable according to the local capacity and resources and that all the elements needed for execution are familiar to key local staff members. All the documents are annexed to this report (see Annexes 4-7) and have been shared with DEMA (printed and electronic versions) and made available publicly via Research Gate (see Annex 2).

Delay in the processing of the drone imagery and production of habitat mapping was mainly due to restructuring of Kew's Science Department during the life of the project; however, we feel that the identified CCAs are the priority areas to start the implementation of the restoration strategy and enough information on those areas had been acquired during the project and made available to our local partner, DEMA. The finer scale analysis of the aerial imagery and models will be shared with DEMA when available. Since the leader of the GIS unit undertaking these analyses wants to publish the results, the expected delivery of the processed data is late 2016.

Some of the implications of the results and outputs to mitigating climate change and invasive pests included:

- Mapping of Core Conservation Areas (CCAs) taking into account resilience to the effects of climate change (slightly raised areas) and pests (presence of trees showing some resistance to infestation by pine tortoise scale insect) and regeneration potential (mature live trees) to help maximise restoration efforts.
- Detecting and identifying chemical compounds related to tree's resistant to the scale insects. This could possibly be used for developing natural 'repellents' to avoid infestations. Additionally, aerial dispersal of pine tortoise scale insect crawlers revealed that insects can move across the area making pest control more difficult.
- Areas currently without pines but with *Coccoloba* spp. could also be used for restoration, as mycological research found that both species share an ECM fungal taxa, which can expand choice for restoration areas in face of heavy pine tree death and future sea-level rise. It also revealed that pines grown in the local nursery following the 'Protocols' (indicator 0.2 document 'b') have a high

level of mycorrhizal colonization in their roots; which is essential for pine establishment in re-introductions and improve water uptake by the trees.

- High water stress increases scale infestation. This is of concern as climate change predictions estimate higher water stress in these low lying islands in the future. The PVA models indicated that all sample (plot) populations would steadily decline in the next 20 years without any assisted restoration efforts, as seed production is low and infestation levels high. Thus, recommendations in the restoration strategy included planting trees in slightly raised areas near mature reproductive individuals to encourage natural regeneration, making sure new saplings already have ECM fungi to help reduce water stress and above all keeping the *ex-situ* collection live, propagating and cultivating new trees to be able to implement the restoration strategy and avoid the extinction of the Caicos pine from TCI.
- The strengthened *ex-situ* collections (higher number of plants, more genetic diversity and long-term seed storage) increased the potential of the taxa to resilience to pests and climate change.



Figure 5. CPRP Nursery Officer Junel Blaise from DEMA growing Caicos pine trees from seed at NCGF project nursery in TCI (left). Kew staff Marcella Corcoran training nursery officer and TCI Project Manager to stock check and monitor tree health of pine trees ready for planting out in the pine yards (right).



Figure 6. Key project staff from DEMA and Kew working together during fieldwork in TCI to optimise post-harvest seed processing methodology for the protocols (left). Project nursery officer Junel Blaise clearing broadleaf in the pine yard as part of forest management training during the project.

## 2.4 Sustainability and Legacy

One of the major project legacies and a crucial element in conserving the Caicos pine in the future and implementing the strategy was ensuring there is local capacity (indicator 3a) and infra-structure in place (working nursery, main equipment needed to carry out forest management and re-introduction) and a representative *ex-situ* collection (indicator 2b). Collections are held in a local nursery on North Caicos

and also safeguarded at the MSB in the UK, (indicators 2b and 2c) so even if climatic events (hurricanes, drought) and lack of resources damage or reduce the living collection in TCI there are seeds available to re-start the nursery. TCI project staff fully trained during the project included a permanent member of staff (Nursery Officer) and a long-term employee (TCI Project Manager) on short term contracts. However, the 'Protocols' delivered will also ensure that propagation and cultivation can be undertaken successfully, even if there are changes in staff in the future years. DEMA is following up with the TCI government on the approval of four staff posts requested for this financial year's budget to carry out the full implementation of the strategy through the Caicos Pine Recovery Project (CPRP). However, it already showed commitment by supporting the trained staff to start implementing the strategy. Monitoring of health of the trees and pest management by DEMA is on-going and reports will be sent to Kew regularly following monitoring of permanent and restoration plots and any new plantings so data can be added to Kew [UKOTs Online Herbarium](#).

The delivery of the documents listed in section 2.1 (indicators 0.1 and 0.2) is a legacy to the TCI people, as it documented scientific research and socio-economic history of the endemic National Tree the Caicos Pine. It will also be the basis of conservation action in the country when implemented. The documents published are of scientific interest to the wider international community and were made available electronically with open access via Research Gate (reaching 136 reads from April 6<sup>th</sup> to 19<sup>th</sup>). During the project the team managed to have a prolific publication list locally and internationally contributing to conservation awareness and scientific knowledge (Annex 2). Schools visits from primary to undergraduate levels to the NCGF project nursery and pine yards, DEMA participation in TCI Annual National Science Fairs, workshop for community and schools in North Caicos and science career events for schools in Providenciales by Kew and DEMA staff (Figure 7, field reports (see Annexes 8-11) and ['Recovering Habitats- Turks and Caicos Islands' storify](#)) were very important as many students have never seen their National tree, the Caicos pine, and were completely unaware of its threat with extinction and what is being done to conserve it. The project has been well represented on social media in the [CPRP Facebook page](#), [TCI Environmental Club Facebook page](#), [Kew UKOTs team @KewUKOTs \(#kewtci\)](#) and the local [TCI CPRP Manager](#) postings on Twitter and Storify available at <https://storify.com/KewUKOTs/recovering-habitats-turks-and-caicos-islands>. [A CPRP project webpage is now available at DEMA's website](#). The Governor's office and TCI press have been actively following and re-tweeting posts. At the end of the project we feel that the community was engaged and outreach recommendations added to the restoration strategy document and DEMA is keen on carrying on with outreach activities.

The synergetic nature of this Darwin Plus project and activities funded by the John Ellerman Foundation, which was just granted after the Darwin Plus grant was secured, led to the design, execution and launch of ['The Caicos Pine Yard Trail- The National Tree Ramble'](#) on Middle Caicos. This new self-guided trail (see Annex 12) through the pine yard incorporated elements of the main project to highlight the on-going research, monitoring, threats, forest management and biodiversity in this ecosystem raising awareness about local conservation. Long-lasting (i.e. waterproof, UV resistant) interpretation panels have been installed in key areas in Middle Caicos, North Caicos and Pine Cay and a display was created at the National Environmental Centre (NEC) in Providenciales (Figure 7). Long-lasting self-guides were made available at the trailhead and also distributed to local hotels and ecotourism companies. The trail which is the first of its kind in TCI was very well received by the community, local ecotourism companies, government officials and TCI Tourist Board which included it on the [Visit Turks and Caicos Islands](#) webpage. This will be a long-lasting legacy which can boost the ecotourism economy, besides being a useful conservation tool and educational resource. This additional funding also helped to rescue part of the socio-cultural history of the islands through the [Caicos Pine Recovery Project Socio-cultural History Report](#), which was made available electronically and open-access.

Therefore, the project enabled to rescue the importance of the National Tree and expose its threats and conservation efforts to the community, media and TCI officials; having a long-term impact through the Caicos Pine Yard Trail being now part of local ecotourism supported by the Tourist Board.





Figure 7. TCI HE Governor Peter Beckingham reading interpretation panels at the entrance of The Caicos Pine Yard Trail on Middle Caicos during unofficial visit with ecotourism company Big Blue Unlimited (left). Project Co-Ordinator Dr. Sanchez talking to local students about the Caicos pine at the NEC in Providenciales during workshop organised by Kew and DEMA (right).

### 3 Project Stakeholders/Partners

The main project partner is the TCI Department of Environment and Maritime Affairs (DEMA) with whom Kew has a long-standing working relationship and detailed Memorandum of Collaboration. DEMA has been fully involved in delivering the project outcomes through local project management including continued liaison with local community, field support for visiting researchers, supervision of nursery officer and collection of data and samples following required training. The existing nursery officer for the *ex-situ* pine collection in TCI (DEMA funded) has been responsible for the daily management of the nursery and was able to increase the number of trees and their health condition during the project and successfully plant out trees in the seed orchard and restoration plots. He and the project manager have been fully trained to execute the activities necessary for the implementation of the protocols and strategy (see 2.2 above). The TCI Project Manager has taken the lead in community engagement and support to the project, supervising the nursery officer, sourcing equipment needed, carrying out forest management and sorting out necessary permits and logistics for fieldtrips. He has been actively engaged in providing feedback and helping Kew experts to set out, refine and trial the protocols and writing the final restoration strategy. Mrs Amy Avenant, Environment Outreach Coordinator for DEMA has been thoroughly engaged and was instrumental in organising launch and career events as well as dealing with the press. Mrs Avenant and DEMA Assistant Director for Research and Development Dr Eric Salamanca have also participated in meetings to discuss and approve the restoration strategy document. New DEMA's director John Claydon is also supportive of the project and has delivered speeches during the launch of the trail and release of the restoration strategy.

The Pine Cay Homeowners Association (PCHA) and the Meridian Club on Pine Cay have been key partners providing free transport and local logistics on the island of Pine Cay (Figure 4). They were fully supportive and accommodating during field visits, including offering transport during the off-season so that seed collections could be secured by DEMA staff and providing accommodation at the Meridian Club so researchers could do water stress measurements before dawn.

Local communities on North and Middle Caicos have been supportive throughout and are updated by visiting researchers and DEMA on a regular basis through community meetings, interviews with local press and school visits. Positive feedback and support from the community, other DEMA staff and TCI's Governor's office was received in person during workshops and local visits or through Twitter. The launch of The Caicos Pine Yard Trail during the project provided a chance to engage with local business and community members and a huge list of places were visited to hand out the fliers and talk about the trail and pine yards (detailed in Annex 10), including Big Blue Unlimited ecotourism company, Daniel's Café restaurant on North Caicos, Blue Horizon Resort on Middle Caicos and TCI National Trust. All were very excited with all the conservation work being carried out through the project and the new opportunities for tourism and education the trail provided.

The US Forest Service has provided prescribed fire training and fire management support during the project, issuing 'basic wildland fire' certificates to four members of DEMA staff. They have also

produced a detailed report during field activities in 2014 on the restoration of fire into the Caicos pine yards which is a main element for the Caicos pine forest management and was incorporated into the final Restoration Strategy document (see Annex 7 pg. 38). The TCI Fire Department has been involved during the prescribed fire activities. Interaction with other stakeholders was increased in the second year of the project, i.e. TCI Tourist Board and TCI Department of Education.

## **4 Lessons learned**

Overall the project has gone smoothly, especially considering the impact of hurricanes and flooding in TCI as well as the complete restructuring of the Science Department at Kew and change of DEMA's director. These issues were well outside the control of the project team but were handled well to ensure that the project moved forward successfully. We secured matched funding from the John Ellerman Foundation that has enabled a considerable amount of additional activities (section 2.4). This funding has been a huge help and enabled the project to do many activities and boost considerably community engagement, but has also brought considerable additional administration responsibilities and practical challenges that were not originally planned. This has meant that the Project Leader (PL), Project Co-Ordinator (PCO) and TCI Project Manager (TCI PM) have had to commit a considerable amount of additional time to deliver these activities. For the second year, the PL has agreed additional time with senior management to address these activities and has identified key periods for project administration to be undertaken.

The management structure was adequate and worked well. It was excellent to have a TCI PM to engage with the community, supervise the nursery and forest management activities and deal with the press throughout the year. The PCO was able to combine research activities with project finances, logistics for fieldwork and reports and support the PL and TCI PM; besides leading on the interpretation for the Trail and drafting of or leading on final output documents. The experience of the PL of working in projects in Caribbean countries and of collaborating with DEMA in TCI for the past decade was crucial to the project's success in delivering all the final outputs (e.g. protocols and strategy). The multi-disciplinary expertise of the project team ensured the successful delivery of the outcomes.

Engagement with local TCI officials was done mainly through scheduled meetings and their participation in launch events. Meetings had to be re-schedule several times due to unfortunate concomitant commitments by the officials and short and busy visits by the Kew team. However, in Kew's staff absence the meetings were attended by DEMA's director and/or project staff and then reported back to the project team. The change of DEMA's director throughout the project (5-month process) also delayed some the involvement of higher officials. However, the team's effort throughout the project with support from DEMA enabled engagement with TCI Prime Secretary in the Ministry of Health Mrs Desiree Lewis, TCI HE Governor Peter Beckingham, TCI Hon Minister of Tourism, Environment, Heritage and Culture Porsha Stubbs-Smith, the Director of Department of Agriculture Mrs Wilhelmina Kissoosinghe, Director of Department of Education Mr Edgar Howell and District Commissioners in North and Middle Caicos, whom informally demonstrated support to the Restoration Strategy.

Social media has been an excellent way to engage the community in real time and reach a wider audience. It proved very effective in raising awareness about the project and documenting activities.

### **4.1 Monitoring and evaluation**

There were no major changes to the project design. Project progress towards outcome was monitored through the project work plan and an annual work plan that was developed in consultation with DEMA at the beginning of the project. Reports (see Annexes 8-11) generated following field visits and prior to quarterly meetings by Kew and TCI team members provided were measured against the assumptions identified in the work plans and assessed by the project steering committee (specifically staff from DEMA and Kew). Any required updates or changes to the work plan were agreed by the committee at quarterly meetings.

The Project Leader, Project Co-Ordinator and TCI Project Manager have been in regular contact with the rest of the team and partners throughout the year to prompt actions or make sure that key elements of the project were delivered on schedule and on budget; being also responsible for logistics and finance.



Reported progress on the several areas by the team were compared against the respective baseline information gathered in the beginning of the project (initial situation of the *ex-situ* conservation efforts, genetic variation in the Bahamas archipelago, known mycological associations in the region, existing chemical compounds found in pines and restoration principles for limestone forest ecosystems) to ensure the project was delivering successfully against the outputs.

The internal evaluation of progress towards the outcome was done through the completion of the main activities and outputs set out in the project. This ensured that scientific data, living plants, seed stock as well as adequate and relevant staff training were in place for the production of the protocols and delivery of the Restoration Strategy at the end of the project. Two field visits a year to TCI ensured that any problems or concerns arising were addressed and the methodology and standards for the protocols could be tested in country with partner feedback. Team meetings throughout the project enabled discussions, collaboration and addressing timely any concerns or problems arising.

The monitoring and evaluation system worked well and allowed addressing issues along the project to ensure the timeframe was followed and outputs were delivered.

## **4.2 Actions taken in response to annual report reviews**

During the second year the project team tried to incorporate into the activities and monitoring some of the feedback received from the annual review. We focused on making sure that the key DEMA staff was fully trained and comfortable performing all the activities required for the implementation of the strategy, monitoring their progress during fieldwork and through frequent communication and report on activities. We have also kept frequent contact with the project team to ensure that the scientific research would be delivered on time. The half year report of Year 2 included field reports (Annexes 8 & 9 below) and photographic evidence of the activities as suggested during the review process. Another area of focus was community engagement and outreach to raise awareness about the importance of restoring the pine forests and building momentum for the implementation of the strategy. We created opportunities to engage local community and officials through the Caicos Pine Yard Trail pre-launch and launch, workshops, native plant garden and interviews for the socio-cultural report (Annex 7). Before the end of the project, the team pulled together to deliver all the research and protocols needed for the restoration strategy, which required close monitoring and evaluation by the Project Leader and Co-Ordinator. The launch of the restoration strategy at the Premier's office in TCI was led by partner DEMA and included high level support from TCI Governor, TCI Minister of Tourism, Environment, Heritage and Culture, Director of Department of Agriculture and many representatives of the local press.

## **5 Darwin Identity**

The Darwin Initiative support is recognised as part of the overarching 'Caicos Pine Recovery Project', which is a long-term collaboration between Kew and TCI to save the Caicos pine. However, the Darwin Plus project has very specific objectives that sits inside the main umbrella project and is always formally recognised as such. There has been several projects in TCI in the past with funding from the Darwin Initiative and the Institution is well-known in TCI and the Caribbean region, being familiar to the research community and TCI Government and NGO staff.

The Darwin logo has been used extensively. It was specifically used for posters/interpretation panels produced and displayed at the National Environmental Centre on Providenciales and in the three TCI pine yards. It was also used for interpretation material for The Caicos Pine Yard Trail, including the signage, interpretation panels (Figure 8), guide (see Annex 12) and fliers. The interpretation panels and our public presentations have all included details about Darwin Plus funding and the official project name was mentioned. Several articles about the project were written for TCI and UK magazines with the funding from Darwin Plus acknowledged. Other publicity included a blog about the project on the Kew website, two articles for the Darwin Initiative Newsletters and active reporting of activities through Twitter (#KewTCI [@BNaqqi, @KewUKOTS]). The project was also publicised through a talk at Kew as part of the Brown Bag Seminar Series and poster presentations at the Pine Rockland Working Group Symposium in Miami, Florida, USA and the UKOTCF Sustaining Partnerships: a conference on conservation and sustainability in UK Overseas Territories, Crown Dependencies and other small island communities, Gibraltar. Please see Appendix 2 for detailed information and links for the publications.

# Caicos Pine Recovery Project



The Caicos pine (*Pinus caribaea* var. *bahamensis*), also called the Caribbean pine, is the only native pine tree in the Turks and Caicos Islands (TCI). Besides being the country's national tree, it is essential for the survival of the pine forest.

TCI pine forests, or pine yards, have been under severe attack since 2005 by a non-native scale insect. This insect feeds on the Caicos pine trees, causing their eventual death. Most mature pine trees are now dead or infested and the future of this ecosystem is under serious threat of disappearing forever.



## A unique ecosystem

Pine trees can grow up to 16m in TCI (and over 24m in the Bahamas). Caicos pines are the dominant canopy trees in the pine forests. In the undergrowth, the Sabal palm (*Sabal palmetto*) is a common species, along with a diverse range of trees, shrubs and ground cover. Many unique animals live in these forests, like the TCI rock iguana in Pine Cay.

The pines grow on limestone rock and are adapted to poor soils and drought. To survive in such conditions they have developed a mutually beneficial association with fungi growing on their roots (ectomycorrhizal fungi).

Natural fires in the wet season encourage pine seeds to germinate in this fire climax ecosystem. The bark of the pine trees is thick and flaky, helping them to survive fires. However, if fires are too frequent or occur during the dry season they can kill seedlings and even mature trees.

## Vulnerable forests

Healthy Caicos pines still thrive in small areas of the pine forests, but dead and infested trees are currently the most common sight in TCI.

As a result of this devastation, the Caicos pine has now been listed as a Vulnerable taxon in the IUCN Red List – the global list of threatened species.

Without pine trees there is no pine forest!

## What is killing the pine trees?

The non-native pine tortoise scale insect (*Toumeyella parvicornis*).

This scale insect is originally from North and Central America. It was accidentally introduced to TCI before 2005, where it has become an invasive species.

It feeds only on pine trees, secreting a sugary substance called 'honeydew'. Sooty mould grows on the needles turning them black and decreasing the trees ability to photosynthesise.



## Reasons to save the Caicos pine

- To preserve the pine forest ecosystem and its ecological services, and reduce loss of biodiversity
- To preserve locally adapted trees and the genetic diversity of the Caicos pine – increasing its chances of surviving the impacts of climate change
- To avoid extinction of the TCI national tree

## Where does the Caicos pine grow?

Only on seven islands in the world, all of them located in the Lucayan Archipelago consisting of the Bahamas and TCI.

In TCI there are three pine forests, shown on the map in green, covering a small area of 13km<sup>2</sup> compared to 2,118km<sup>2</sup> in the northern Bahamas, where it grows on the islands of Abaco, Andros, Grand Bahama and New Providence. In 2009, an accidental fire destroyed almost 25% of the pine forests in TCI when over 90% of the North Caicos forest burned.



John Ellerman Foundation



For more information follow us on [#KawTCI](#) or visit the project page on the Kew website [www.kew.org](http://www.kew.org)

# Caicos Pine Recovery Project



The Caicos Pine Recovery Project is a collaboration between the Royal Botanic Gardens, Kew (Kew) in the UK and the Department of Environment and Maritime Affairs (DEMA) in TCI as well as many other local and international partners.

Since 2005, the non-native pine tortoise scale (*Toumeyella parvicornis*) has become invasive in TCI, killing the majority of the native Caicos pine trees in the wild.

The project is researching the Caicos pine (*Pinus caribaea* var. *bahamensis*) and the pine forests in TCI, working to protect the country's national tree and its habitat for the future.

## The Project Goals

- A genetically representative Caicos pine living collection in TCI and a seed collection at Kew's Millennium Seed Bank
- Data and an established methodology for researching the Caicos pine and its ecosystem
- Scientific knowledge and practical experience that can be used to guide the future restoration and management of the TCI pine forests



## Living Collections

- Growing Caicos pine trees in the nursery on North Caicos for re-introduction to the wild
- Collecting pine seeds to sow in the nursery or send to Kew's Millennium Seed Bank (MSB) in the UK for safe storage
- Improving nursery standards and production through specialist horticultural advice



## Permanent Monitoring and Restoration Plots

- Establishing permanent monitoring plots in the pine forests, three on each island of Pine Cay, Middle Caicos and North Caicos, has enabled ongoing research since 2010
- Re-introducing Caicos pine trees in restoration plots on Pine Cay began in 2012 using nursery grown trees
- Recording data annually about pine tree survival, growth rates, pine tortoise scale infestation and new seedlings in all plots

## Scientific Research

- Kew scientists are studying:
- seed storage behaviour
  - pine genetics
  - water relations
  - potential impacts of climate change

- growth requirements
- habitat suitability
- chemical compounds
- ectomycorrhizal fungi
- population viability

Specialised training on scientific data collection is also given to DEMA staff as part of this collaboration.



## Community Outreach

- Exchanging knowledge with the local community and sharing information through workshops, media and community meetings
- Gathering and sharing knowledge about how TCI pine forests are used, such as historical land use and medicinal plants



John Ellerman Foundation



For more information follow us on [#KawTCI](#) or visit the project page on the Kew website [www.kew.org](http://www.kew.org)

Figure 8. Interpretation panels created by Kew and DEMA teams for The Caicos Pine Yard Trail. These panels are displayed in several key locations in TCI, e.g. the NEC in Providenciales, Sandy Point Marina and in the native garden at Kew settlement on North Caicos.

## 6 Finance and administration

### 6.1 Project expenditure

Project spend (indicative) since last annual report	2015/16 Grant (£)	2015/16 Actuals (£)	Variance %	Comments (please explain significant variances)
Staff costs			-1% (-857)	
Consultancy costs			0%	
Overhead Costs			8% (1001)	Currency fluctuations impacted other budget lines and required Kew to claim less overheads.
Travel and subsistence			0% (-54)	
Operating Costs				
Capital items				
Others			1% (-90)	
<b>TOTAL</b>	<b>103527</b>	<b>103527</b>		

Staff employed (Name and position)	Cost (£)
B. Naqqi Manco	
M. Sanchez	
P. Green	
P. Stevenson	
S. Barlow	
L. Martinez-Suz	
T. Wilkinson	
<b>TOTAL</b>	<b>58413</b>

Consultancy – description of breakdown of costs	Other items – cost (£)
TCl based field assistance	
<b>TOTAL</b>	

Other items – description	Other items – cost (£)
TCl consumables	
Kew consumables	
<b>TOTAL</b>	<b>9810</b>

### 6.2 Additional funds or in-kind contributions secured

Source of funding for project lifetime	Total (£)
John Ellerman Foundation	
Bentham-Moxon Trust	

TOTAL	76750
Source of funding for additional work after project lifetime	Total (£)
N/A	0
TOTAL	0

### 6.3 Value for Money

The project was designed and implemented to deliver maximum quality results in a short time with the lowest budget possible. Two trips a year were carried out by Kew staff to deliver training, test protocols and carry out research, and we relied on DEMA staff to carry on with the activities the rest of the year. This worked well and allowed us to maximise the number of people going on each trip which reduced costs considerably as houses and cars were shared (e.g. six people sharing one house instead of having 3 or 4 rooms in a hotel). We used small local businesses whenever possible to provide housing, food and cars; thus being able to negotiate good prices while helping the local economy.

Securing that research was carried out at Jodrell laboratory with no bench fees charged for Kew staff also contributed to savings. The expertise of project staff with the laboratory techniques required for the project saved money on training, minimising waste of reagents and time and allowing delivery of high quality research. Match fund provided by Kew in staff time allowed low project costs for the amount and quality of deliverables.

Horticultural experience of Kew project team and previous baseline data gathered by the Kew UKOTs team for almost a decade was key on saving time developing the protocols and delivering a sound strategy. A long working relationship between Kew and DEMA and the recruiting of local people with experience in the Caicos Pine Recovery project (CPRP) with interested in the project (TCI Project Manager, and Nursery Officer) reduced amount of training needed and number of field trips required saving money, enabling better community engagement, increasing level of feedback for the protocols and strategy and contributing to legacy.

Long term experience of Project Leader and Project Co-ordinator working with DEMA and with the TCI pine yards and carrying out field trips to the area made it possible to organise and deliver successful field trips and training in a short window of time. Their experience with local ecology and monitoring of pine forests in TCI, horticultural techniques, previous research in the area and established network through the CPRP provided the needed understanding to write and edit the protocols and strategy and deliver the outcome on time and on budget.

The synergetic funding from John Ellerman Foundation allowed many extra activities and training needed for the implementation of the strategy to be delivered with many benefits to the project without any additional costs. This included training in forest management with controlled burns, community engagement and awareness raising through interpretation, trail and native garden, besides boosting local green economy.

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## Annex 1: Standard Measures

Code	Description	Totals (plus additional detail as required)
Training Measures		
1	Number of (i) students from the UKOTs; and (ii) other students to receive training (including PhD, masters and other training and receiving a qualification or certificate)	(i) 4 TCI staff received Rx fire certification
2	Number of (i) people in UKOTs; and (ii) other people receiving other forms of long-term (>1yr) training not leading to formal qualification	~
3a	Number of (i) people in UKOTs; and (ii) other people receiving other forms of short-term education/training (i.e. not categories 1-5 above)	(i) 2 TCI DEMA staff
3b	Number of training weeks (i) in UKOTs; (ii) outside UKOTs not leading to formal qualification	(i) 12 training weeks in TCI
4	Number of types of training materials produced. Were these materials made available for use by UKOTs?	One protocols document (Annex 5) was produced by DEMA and Kew in electronic and hard copy formats
5	Number of UKOT citizens who have increased capacity to manage natural resources as a result of the project	2 key DEMA staff throughout the project
Research Measures		
9	Number of species/habitat management plans/strategies (or action plans) produced for/by Governments, public authorities or other implementing agencies in the UKOTs	One restoration strategy and one protocols document produced by DEMA and Kew in electronic and hard copy formats
10	Number of formal documents produced to assist work in UKOTs related to species identification, classification and recording.	One protocols document produced by DEMA and Kew in electronic and hard copy formats
11a	Number of papers published or accepted for publication in peer reviewed journals written by (i) UKOT authors; and (ii) other authors	i) 1 ii) 2
11b	Number of papers published or accepted for publication elsewhere written by (i) UKOT authors; and (ii) other authors	i & ii) 5 articles for magazines in TCI and UK, 2 articles for Darwin Initiative Newsletter and 1 paper for conference proceedings
12b	Number of computer-based databases enhanced (containing species/genetic information). Were these databases made available for use by UKOTs?	Kew's <a href="#">UKOTs Species and Specimens Database</a> (Brahms software) was enhanced and data exported and repatriated to DEMA
13a	Number of species reference collections established. Were these collections handed over to UKOTs?	~
13b	Number of species reference collections enhanced. Were these collections handed over to UKOTs?	404 Caicos pine DNA samples added to Kew's DNA Bank; 873 DNA extractions from roots and fruit body



Code	Description	Totals (plus additional detail as required)
		collections added to Kew's DNA Bank; 37 Mycological samples added to the Kew fungarium. TCI currently lacks the necessary facilities and resources to accept repatriated reference collections. Kew is holding relevant herbarium specimens in cold storage for TCI
Dissemination Measures		
14a	Number of conferences/seminars/workshops/stakeholder meetings organised to present/disseminate findings from UKOT's Darwin project work	2 workshops in TCI
14b	Number of conferences/seminars/workshops/stakeholder meetings attended at which findings from the Darwin Plus project work will be presented/ disseminated	2 international conferences 2 Science Fairs for schools in TCI
Physical Measures		
20	Estimated value (£s) of physical assets handed over to UKOT(s)	~
21	Number of permanent educational/training/research facilities or organisation established in UKOTs	~
22	Number of permanent field plots established in UKOTs	2 permanent restoration plots established on Pine Cay, TCI to complement 5 already existing.
23	Value of resources raised from other sources (e.g., in addition to Darwin funding) for project work	£76750

## Annex 2: Publications

Type	Detail (title, author, year)	Nationality of lead author	Nationality of institution of lead author	Gender of lead author	Publishers (name, city)	Available from (e.g. weblink, contact address, annex etc)
Technical Report	<a href="#">Caicos Pine Recovery Project Scientific Data and Results: Sampling and analyses undertaken</a> . Edited by: Dr Michele D. Sanchez and Dr Martin A. Hamilton (2016)	Italian/ Brazilian	British	Female	Royal Botanic Gardens Kew, UK (see Annex 4: CPRP Scientific Data and Results)	<a href="https://www.hightail.com/download/cUJXQ3R3NDQwVW5WUThUQw">https://www.hightail.com/download/cUJXQ3R3NDQwVW5WUThUQw</a>
Technical Report	<a href="#">Caicos Pine Recovery Project Protocols: Standards and methodologies to conserve the TCI National Tree</a> . Edited by: Dr Hamilton, M.A. and Dr Sanchez, M.D. (2016)	British/ American	British	Male	Royal Botanic Gardens Kew, UK (see Annex 5: CPRP Protocols)	<a href="https://www.hightail.com/download/cUJXQ3R3NDQxUURMYnRVag">https://www.hightail.com/download/cUJXQ3R3NDQxUURMYnRVag</a>
Technical Report	<a href="#">Caicos Pine Recovery Project Socio-cultural History Report: Results and findings of pine yard interviews with Caicos Islanders</a> . Manco, B.N., Dr. Sanchez, M.D., Blaise, J. and Dr Hamilton, M.A. (2016)	American	British	Male	Royal Botanic Gardens Kew, UK (see Annex 7: CPRP Socio-cultural History Report)	<a href="https://www.hightail.com/download/cUJXQ3R3NDQzeUxOTzhUQw">https://www.hightail.com/download/cUJXQ3R3NDQzeUxOTzhUQw</a>
Technical Report	<a href="#">Caicos Pine Recovery Project National Tree Restoration Strategy: 2016-2036 restoration strategy to secure the Caicos pine for future generations</a> . Edited by: Dr Hamilton, M.A., Manco, B.N. and Dr Sanchez, M.D. (2016)	British/ American	British	Male	Royal Botanic Gardens Kew, UK (see Annex 6: CPRP National Tree Restoration Strategy)	<a href="https://www.hightail.com/download/cUJXQ3R3NDRCTWxFQmNUQw">https://www.hightail.com/download/cUJXQ3R3NDRCTWxFQmNUQw</a>

Journal	<a href="#">The scope for using the volatile profiles of <i>Pinus caribaea</i> var. <i>bahamensis</i> as indicators of susceptibility to pine tortoise scale and as predictors of environmental stresses.</a> Green, P.W.C., Hamilton, M.A., Sanchez, M.D., Corcoran, M.R., Manco, B.N. and Malumphy, C.P. (2015)	British	British	Male	Chemistry & Biodiversity, <b>12</b> (4):652-61 (see Annex 13: Green, P.W.C. et al., 2015)	<a href="https://www.hightail.com/download/cUJXQ3QzQzNrUmtpr01UQw">https://www.hightail.com/download/cUJXQ3QzQzNrUmtpr01UQw</a>
Journal	Trapping confirms aerial recruitment of Pine Tortoise Scale ( <i>Toumeyella parvicornis</i> (Cockerell)) (Hemiptera: Coccidae) in the Turks and Caicos Islands. Malumphy, C.P., Hamilton, M.A., Sanchez, M.D. and Green, P.W.C. (submitted - in press)	British	British	Male	Entomologists Monthly Magazine	Chris Malumphy
Int. Conference Proceeding	<a href="#">Caicos Pine Recovery Project - an overview.</a> Sanchez, M. D., Corcoran, M., Clubbe, C., Moat, J., Suz, L. M., Green, P., Davies, R., Barlow, S., Baena, S., Heller, T., Manco, B. N., Blaise, J., Avenant, A., Malumphy, C. and Hamilton, M. A. (2015)	Italian/ Brazilian	British	Female	Sustaining Partnerships: a conference on conservation and sustainability in UK Overseas Territories, Crown Dependencies and other small island communities, Gibraltar 11th to 16th July 2015, 2015, Gibraltar: UK Overseas Territories Conservation Forum: p.108–111.	<a href="http://www.ukotcf.org/pdf/2015conf/SustainingPartnershipsSS1to3.pdf">http://www.ukotcf.org/pdf/2015conf/SustainingPartnershipsSS1to3.pdf</a>
Newsletter	<a href="#">Caicos Pine Forests: Mitigation for Climate Change and Invasive Species.</a> Manco, B.N., Sanchez, M.D and Hamilton, M.A. (2015).	American	British	Male	Darwin Initiative: UK Overseas Territories Newsletter November 2015: p.12.	<a href="http://www.darwininitiative.org.uk/assets/uploads/2014/05/November-2015-Darwin-Newsletter-UKOTs.pdf">http://www.darwininitiative.org.uk/assets/uploads/2014/05/November-2015-Darwin-Newsletter-UKOTs.pdf</a>
Magazine	<a href="#">Kew to Kew Connection.</a> Manco,	American	Turks and Caicos	Male	Times of the Islands.	<a href="https://www.yumpu.com/en/embed/vi">https://www.yumpu.com/en/embed/vi</a>

	B.N. (2015)		Islands		Providenciales, TCI: pg.36-37	<a href="#">ew/MwzFRIBIN9qi3Ddl</a>
Magazine	<a href="#">Burn, Baby, Burn</a> . Manco, B.N. (2015)	American	Turks and Caicos Islands	Male	Times of the Islands. Providenciales, TCI: pg.32-34	<a href="http://www.timespub.tc/2015/03/burn-baby-burn/">http://www.timespub.tc/2015/03/burn-baby-burn/</a>
Newsletter	<a href="#">Burning Caicos pine yards</a> - U.S. Forest Service helps to restore threatened Caribbean rocklands habitat. Hoyle, Z. (2015)	American	American	Female	CompassLive- Southern Research Station, U.S. Forest Service, June 2015.	<a href="http://www.srs.fs.usda.gov/compass/2015/06/30/burning-caicos-pine-yards/">http://www.srs.fs.usda.gov/compass/2015/06/30/burning-caicos-pine-yards/</a>
Magazine	<a href="#">Caicos Pine Recovery Project: Saving the National Tree</a> . Ganosellis, E. (2014).	Unknown	Turks and Caicos Islands	Female	Island Life and Times. Providenciales, TCI.	<a href="http://www.islandlifeandtimes.com/islanders/caicos-pine-recovery/">http://www.islandlifeandtimes.com/islanders/caicos-pine-recovery/</a>
Magazine	A new lease on life for TCI's National Tree: Caicos Pine Recovery project receives funding from Darwin Plus. Manco, B. N. (2014).	American	Turks and Caicos Islands	Male	Times of the Islands. Providenciales, TCI: 23. (see Annex 14: Manco, B.N., 2014.)	<a href="https://www.hightail.com/download/cUJXQ3QzQzNPSHdsYzhUQw">https://www.hightail.com/download/cUJXQ3QzQzNPSHdsYzhUQw</a>
Blog	Rescuing the threatened Caicos pine in the Turks and Caicos Islands. Sanchez, M. D. (2014).	Italian/ Brazilian	British	Female	Royal Botanic Gardens Kew website, UK	<a href="http://www.kew.org/discover/blogs/rescuing-threatened-caicos-pine">http://www.kew.org/discover/blogs/rescuing-threatened-caicos-pine</a>
Magazine	Kew helps to rescue the Caribbean pine. Pain, Stephanie (2014).	British	British	Female	Science News. Kew Magazine Autumn 2014: pg. 24. (see Annex 15: Pain, S., 2014.)	<a href="https://www.hightail.com/download/cUJXQ3QzQzNnYU5BSXRvag">https://www.hightail.com/download/cUJXQ3QzQzNnYU5BSXRvag</a>
Newsletter	<a href="#">Multi-disciplinary research and international collaboration to rescue the Caicos pine forests</a> . Sanchez, M.D., Naqqi, B.N.M., Hamilton, M.A. (2014).	Italian/ Brazilian	British	Female	Darwin Initiative: UK Overseas Territories Newsletter August 2014: pg.9.	<a href="http://www.darwininitiative.org.uk/assets/uploads/2014/05/Darwin-Initiative-Newsletter-UKOTs-August-2014-v2.pdf">http://www.darwininitiative.org.uk/assets/uploads/2014/05/Darwin-Initiative-Newsletter-UKOTs-August-2014-v2.pdf</a>

### Annex 3: Darwin Contacts

Ref No	DPLUS016
Project Title	Caicos pine forests: mitigation for climate change and invasive species
Project Leader Details	
Name	Dr Martin A Hamilton
Role within Darwin Project	Project Leader
Address	Royal Botanic Gardens, Kew The Herbarium, Richmond, TW9 3AE, UK
Phone	
Fax/Skype	
Email	
Partner 1	
Name	John Claydon
Organisation	Department of Environment and Coastal Resources
Role within Darwin Project	Director
Address	Lower Bight Road, Providenciales, Turks & Caicos Islands
Fax/Skype	
Email	



## **Annex 4: CPRP Scientific Data and Results**

Sanchez, M.D. et al., 2016. *Caicos Pine Recovery Project Scientific Data and Results: Sampling and analyses undertaken* M. D. Sanchez & M. A. Hamilton, eds., Richmond, Surrey, UK: Royal Botanic Gardens, Kew.

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## **Annex 5: CPRP Protocols**

Sanchez, M.D. et al., 2016. *Caicos Pine Recovery Project Protocols: Standards and methodologies to conserve the TCI National Tree* M. A. Hamilton & M. D. Sanchez, eds., Richmond, Surrey, UK: Royal Botanic Gardens, Kew.

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## **Annex 6: CPRP National Tree Restoration Strategy**

Hamilton, M.A. et al., 2016. *Caicos Pine Recovery Project National Tree Restoration Strategy: 2016-2036 restoration strategy to secure the Caicos pine for future generations* M. A. Hamilton, B. N. Manco, & M. D. Sanchez, eds., Richmond, Surrey, UK: Royal Botanic Gardens, Kew.

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## **Annex 7: CPRP Socio-cultural History Report**

Manco, B.N. et al., 2016. *Caicos Pine Recovery Project Socio-cultural History Report: Results and findings of pine yard interviews with Caicos Islanders*, Richmond, Surrey, UK.: Royal Botanic Gardens, Kew.

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## **Annex 8: TCI field visit report, OFC 417-9, April 2015**

Corcoran, M., 2015. *Turks & Caicos Islands, field visit report, OFC 417-9, April 2015*, Richmond, Surrey, U.K.: Royal Botanic Gardens, Kew.

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## **Annex 9: TCI field visit report, OFC 417-10, May 2015**

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## **Annex 10: TCI field visit report, OFC 417-11, November 2015**

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## **Annex 11: TCI field visit report, OFC 417-12, March-April 2016**

Hamilton, M.A., 2016. *Turks & Caicos Islands, field visit report, OFC 417-12, March-April 2016*, Richmond, Surrey, U.K.: Royal Botanic Gardens, Kew.

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## **Annex 12: Caicos Pine Yard Trail: The National tree ramble**

Manco, B.N., Hamilton, M.A. & Sanchez, M.D., 2015. *Caicos Pine Yard Trail: The National tree ramble*, Richmond, Surrey, U.K.

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### **Annex 13: Green, P.W.C. et al., 2015**

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### **Annex 14: Manco, B.N., 2014.**

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### **Annex 15: Pain, S., 2014.**

Pain, S., 2014. Kew helps to rescue the Caribbean pine. *Kew Magazine*, p.24.

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