Darwin Initiative: Final Report

Darwin Project Information

Project reference	Project 23-004 ref 3339
Project title	Ex-situ conservation of threatened plants from the Ivoloina-Ifontsy valleys, Madagascar
Host country(ies)	Madagascar
Lead organisation	Madagascar Fauna and Flora Group (MFG)
Partner institution(s)	Missouri Botanical Garden (MBG); Royal Botanic Gardens, Kew (RBG, Kew); *Silo National des Graines Forestières (*SNGF)*; Parc Botanique et Zoologique de Tsimbazaza* (PBZT)
Darwin grant value	£235,894
Start/end dates of project	April 2016 to March 2019
Project leader's name	Karen Freeman
Project website/blog/Twitter	Website: http://www.madagascarfaunaflora.org/darwin-initiative.html; Twitter: @DI_gasyplants
Report author(s) and date	Karen Freeman and Chris Birkinshaw, June 2019

1 Project Rationale

The Malagasy flora is both exceptionally rich (14,000 species) and highly endemic (90%) (Callmander et al 2011). However, it is also very threatened by anthropogenic activities (e.g. shifting cultivation, wild fires, charcoal production etc.). Between 1950 and 2000 40% of remaining forest was destroyed (Harper et al 2007) and forest loss continues today at a similar pace. In eastern Madagascar most forest outside of protected areas will be lost in the next decade. An analysis of data concerning Malagasy plants in the TROPICOS online database (http://www.tropicos.org/Project/Madagascar) suggests that an estimated 14% of the flora is not included in any protected area. Many of these excluded species occur as tiny populations in small, degraded fragments of natural vegetation where they are exceptionally vulnerable. Ideally, these habitats should be conserved but this rarely occurs because of their small size and degraded nature. Thus, the most viable alternative to extinction for these species will be *ex-situ* conservation, either as growing plants in secure collections or as seeds in seed banks. Yet investment in *ex-situ* plant conservation in Madagascar is inadequate. This project was designed to respond to this need – albeit within a limited part of Madagascar: the Ivoloina and Ifontsy River Valleys (see map in Annex 7.10). This area was selected as the target for this project because here natural vegetation has almost all been destroyed and the small remaining forest fragments (see Annex 7.1., photo 1.) are likely to be lost imminently. Thus, this project truly represents the last chance to save this botanical diversity. By demonstrating the success of this approach, we expect that this project will act as a model for similar initiatives elsewhere in Madagascar and perhaps beyond.

Callmander M. W. et al. 2011. Plant Ecology and Evolution, 144(2): 1

Harper G.J. et al. (2007). Environmental Conservation 34 (4): 1-9

2 Project Partnerships

This project was based on the solid foundation of a trusting and long-standing partnership between Madagascar Fauna and Flora Group (MFG) and Missouri Botanical Garden (MBG). Formally MFG has been responsible for managing the budget and the *ex-situ* propagation and planting-out aspects of the project, and MBG was responsible for fieldwork to collect vouchered seed samples, species identifications, building community relationships in the collection zone and entering results into the international plant database - TROPICOS. However, MBG technical staff were involved in all aspects of the project, lending expertise as required to ensure the smooth running and efficacy of the two Darwin Initiative plant nurseries at Parc Ivoloina. Chris Birkinshaw, Botanical Director for the project, has been integral to the management of the project and is, in reality, a joint Project Leader. All major decisions as regards the direction of the project have been made jointly between MFG and MBG and this final report has been written jointly between the two partners. These two organisations have collaborated in Madagascar for over 3 decades, and this project has served to further cement the relationship and exemplify the benefits of effective partnerships to achieve challenging goals. As reported in Section 5, during the remainder of 2019, 2021 and into 2022, with funding from new sources, the two organisations will continue to collaborate in *ex-situ* plant conservation work based at Parc Ivoloina.

The partnership with Royal Botanic Gardens, Kew (RBG-Kew) was fruitful and effective and we much appreciated their major role in the training aspects of both horticulturalists and field botanists and their contributions to the initial collection trips. RBG-Kew were also responsible for exporting from Madagascar, receiving and conserving long-term a sub-set of the seeds collected through the project in their Millennium Seed Bank (MSB) in the UK.

The association with *Silo National des Graines Forestières* (SNGF, attached to the *Ministère de l'Environnement, de l'Ecologie et des Forêts*, Madagascar) was effective throughout the project despite a change in directorship. The agreements signed between MFG and SNGF are included in Annex 7.2 of this report and details provided of SNGF's role in training the field botanists on best practice for seed collection, in receiving a sub-set of seeds from the project for *ex-situ* conservation at their own facility (either through propagation and plantation or freezing in their own seed bank) and triage of seeds for export to the MSB. A full inventory of the seed samples dispatched to SNGF can be downloaded at the bottom of the DI webpage https://www.madagascarfaunaflora.org/darwin-initiative.html.

As per the agreement between MBG and the Parc Botanique et Zoologique de Tsimbazaza (PBZT), attached to the Ministère de l'Enseignement Supérieur et de la Recherche Scientifique, three young plants of seed samples successfully propagated in adequate numbers were sent to PBZT for planting in their own garden, thus providing a further safety-net for these plants. In total during the project, plants originating from 249 seed samples were dispatched to PBZT, totalling 659 seedlings. A full inventory of these plants can be can be downloaded at the bottom of the DI webpage https://www.madagascarfaunaflora.org/darwin-initiative.html. Botanists from PBZT also periodically joined the field work and in total contributed a total of 48 person-days to the project.

All partners in the project were represented at the official launch of the Darwin Initiative plant nursery at Parc Ivoloina in July 2017. The event, led by the British Consul for Madagascar, Michel Gonthier, ably demonstrated both the independent identity of the Darwin Initiative project and also the successful partnerships behind it.

An unexpected partnership that developed during the project was with a village association called "Lovasoa". This association is dedicated to the conservation of a cluster of six forest fragments that have a total area of 90 hectares and are known collectively as the Ampasina Forest. We were able to recruit some association members as community seed collectors – with benefits both to this association and to our project. Building on the relationships developed through this collaboration, Chris Birkinshaw has helped the association submit an application for funds for their on-going conservation work and will endeavour to support this association in similar ways in the future. MFG have also just sent a large contingent of their management and plant nursery teams to participate in a forest restoration event at Ampasina organised by Lovasoa, as well as providing plants from the MFG nurseries.

During the 3 years of its duration, the project was able to benefit from special expertise within the partner organisations. Ingrid Porton, Vice President of Conservation and Research of MFG, generously invested a significant amount of time in designing a beautiful and informative project website (http://www.madagascarfaunaflora.org/darwin-initiative.html); Brock Mashburn, Horticulture Department, MBG, advised the Darwin Initiative's horticulture team on best practises for plant propagation; and Rebecca Sucher, Senior Manager, Living Collections at MBG, facilitated a trial of the integration of our accession database into MBG's Living Collection Monitoring System.

3 Project Achievements

3.1 Outputs

Output 1*. Training and capacity building provided to enable four young Malagasy men/women to organise field trips, conduct botanical inventories, and collect high quality seed samples for ex-situ conservation*

This output has been entirely achieved. The candidates interviewed for this training opportunity can be seen in Annex 7.3, and the *Curriculum Vitae* (CV) of the four that were selected, 2 males and 2 females, can be seen at Annex 7.4. The training is illustrated in Annex 7.1, photo 2. At the end of the training the four trainees were all evaluated as capable of organising field trips, conducting botanical inventories and collecting high quality seed samples. Their formal final examination results are included in Appendix 7.5 of this report along with the results for Jose Roli Sylvain, the MFG Botanical Conservation Agent who was able to benefit from large sections of the training course. Sylvain was not able to attend the full course due to some prior work commitments) but profited greatly in his field species identification and preservation techniques. Together the field botanists, under the coaching and leadership of Patrice Antilahimena and Richard Randrianarivo, were responsible for collecting 953 seed samples each with a voucher herbarium specimen. In addition, they collected 853 herbarium specimens without seed samples as part of the general botanical inventory of the area. Since the conclusion of their work, three of the four have found new employment that makes use of their skills: Rajaijaona Benjamina is now assistant project manager at Analalava Reserve, Rakotonirina Arsene Giovanni is studying for his PhD in plant ecology; and Syde Remi Anthony is a field botanist with MBG's conservation project at Pointe à Larrée. Rasoanindriana Maheninsoa Harisandy is currently unavailable for field work because she has recently given birth but was employed until the end of the Darwin Initiative project to maintain the project plant database. Written evaluations of the newly-trained botanists are available on request.

Output 2*. Training and capacity building provided to enable six young Malagasy men/women the skills necessary to propagate and nurture native Malagasy plants*

This output has also been entirely achieved because, through the comprehensive project training programme, six trainees developed into knowledgeable, skilled and motivated horticulturalists. The applicants for this training opportunity are listed in Annex 7.7, and the CVs of those selected shown in Annex 7.8: Three of those selected were male and three were female. Early in the training one trainee, Nelson Roger, left and was replaced by Sandra Rakotomanana. The training is illustrated in Annex 7.1., photo 3. Copies of the horticulturalists' mid-training and final evaluation marks are included in Annex 7.9. During the project the horticulturalists, under the leadership and coaching of Alex Mamisoa, received, accessioned, and attempted to propagate 856 seed samples, and then labelled, planted-out and monitored the resultant seedlings. The maintenance of the accession database with some 77 fields was a major challenge and this work took much more time than anticipated. Of the six horticulturalists, five have already found employment that makes use of their skills: Philemond Jeannot and Antonio Platini have been retained at Parc Ivoloina to continue on-going *ex-situ* plant conservation work; Rajaonarivelo David has been employed as nursery manager at the Ankaraboalava-Agnakatrika protected area in SE Madagascar, and Mandimbiosa Lalaina Nina, and Bodotahina Sandra have been recruited by the landscape design company Phytologic. This company specialises in using the Malagasy flora in the gardens and landscapes that they create. Written evaluations of the newly-trained horticulturalists and scanned copies of the written final examination papers are available on request.

Output 3. *Vouchered and genetically diverse seed samples collected for at least 500 endemic Malagasy species from remaining native forest fragments within Ivoloina-Ifontsy River Valley*
During the project, the field botanists collected a total of 953 seed samples. The field work to collect these samples is illustrated in Annex 7.1, photo 6, and some examples of the seed samples are shown in Annexe 7.1. photo 7. To date, 98.8%, 99.5% and 75.5% of the voucher specimens associated with these samples have been identified to the level of family, genus and species respectively. Assuming that the specimens not yet identified to family or genus are all species not included among the plants already fully identified, then we have collected 618 species, in 88 different plant families, and so have surpassed our desired goals for the project. 90 species were sampled on multiple occasions from different forest fragments. This repetition is desirable because it increases the overall genetic diversity of the plants conserved in *ex-situ* conservation collections. A full list of the collections is too bulky to be included in this report but an example of the data associated with one collection (code RBM128), as presented in the database TROPICOS, is shown in Annex 7.11, and a full list of collections can be can be downloaded at the bottom of the DI webpage https://www.madagascarfaunaflora.org/darwin-initiative.html.

As planned, the four Darwin Initiative field botanists worked for the first two years of the project only so that the seed samples collected could be propagated and planted prior to the end of the project. However, in Year 3 we accessed a new source of funds to permit the propagation of seeds for another year after the conclusion of the DI project, and with this capability, we therefore decided to support two more field trips in February and March 2019. These trips included six young Malagasy who were being trained as field botanists to serve on the site-based teams of six new protected areas. In total these trips yielded 103 additional seed samples that are included in the quantities provided in the previous paragraph. These samples are currently being propagated in the nursery at Parc Ivoloina.

It should be mentioned too that, while the seed samples were the main objective of the field work, the voucher herbarium specimens themselves are of great significance in increasing knowledge of the as yet, poorly known, Malagasy flora. It is these specimens that constitute the raw material on which plant taxonomy is based and the field notes that accompany each specimen contribute to our knowledge of the distribution, ecology, use and status of Malagasy plants. Each voucher was collected in replicate so that one specimen could be left in Madagascar, while the remainder could enrich herbaria around the World. Typically, each specimen was also accompanied by a digital photo that was also uploaded into the freely available electronic database TROPICOS and a labelled fragment of leaf that was immediately preserved in silica gel. These silica gel leaf samples are lodged in MBG's DNA library (Annex 7.1 photo 17) that can be freely accessed by plant taxonomists for use in taxonomic studies based on DNA. In addition to the 953 herbarium specimens collected as vouchers to seed samples, an additional 1124 specimens were collected without seed samples because the plants from which they originated were considered of especial interest to the botanists.

Although this project is not specifically targeted on any specific groups of plant, and rather considers all native plant diversity within the doomed forests as being worth conserving, it is satisfying to note several important species among our collections including species of *Vitex* (Lamiaceae), Beguea (Sapindaceae) and *Melanophylla* (Toricelliaceae) that are new to science, and collections from several sub-populations of *Dracaena umbraculifera,* a plant that had been thought to be extinct in the wild. However, at least four other species new to science were seen and vouchered without seed samples being collected because mature seeds were not available at the time of the visit (for one such species see Annex 7.1., photo 18). These plants will be the subject of future targeted conservation work that hopefully will be funded through a grant from the Association of Zoological Horticulture (application submitted 23/06/19 and available on request).

Output 4. *At least 500 vouchered, genetically-diverse, endemic Malagasy flowering plant species conserved ex-situ*

For the 953 seed samples collected: 856 samples (618 species) were sown in the nursery at Parc Ivoloina, and 260 samples (194 species) were sent to SNGF for preservation in their seed bank and for dispatch to the Millennium Seed Bank. Fewer samples were processed for ex-situ conservation than were collected because, on examination at Parc Ivoloina, some samples were found to be predated or rotten. Among the 856 samples sown at Parc Ivoloina seeds from 681 samples (467 species) had germinated by the end of the project. Among these, 14,765 seedlings of 439 different samples (265 species) had been planted out at Parc Ivoloina. Seedling mortality to date is 29%. Thus as a maximum, 528 species have been conserved ex-situ by this project and, hence, the project target attained. This figure includes species already planted in the Parc, species remaining in the nursery, and species dispatched to the SNGF seed bank. It is also based on the assumption that currently unidentified species are different from those already identified. The raw data on which this summary is based can be found at the bottom of the DI webpage https://www.madagascarfaunaflora.org/darwin-initiative.html.

3.2 Outcome

Our proposal identified two indicators of the project outcome:

1 Number of Malagasy plant species preserved using ex-situ conservation measures increases from baseline of ca. 2100 species (the number of species conserved *ex-situ* in the seed banks and Parc Ivoloina) to ca. 2600 species

2 Ten newly-trained Malagasy field botanists and nurserymen/women intervene effectively to reduce the risk of extinction of their flora through *ex-situ* conservation

With respect to the first indicator, taking into account that voucher specimens currently unidentified are assumed all to be different species, we estimate that 528 species have been conserved by this project. In addition, 90 species are represented by samples from more than one sub-population. Full list of collected samples available to download at the bottom of the DI webpage https://www.madagascarfaunaflora.org/darwin-initiative.html
The 2,100 species quoted in Outcome 1 are the estimated number of species of Malagasy plants that were in the RGB-Kew Millennium Seed Bank at the start of this project. The vast majority of plants propagated ex-situ at Parc Ivoloina (467 species that have germinated successfully to date, of which 265 species have already been planted out around Parc Ivoloina) had recalcitrant seeds, which are not suitable for preservation in seedbanks and, hence, these species are likely to not be included in the existing 2,100 Malagasy species already being conserved ex-situ at the MSB. It is also likely that many of the 194 species dispatched for conservation in seedbanks through this project will be additional species to the 2,100 species already conserved. A full reckoning of our success in achieving Outcome 1 will not be possible until the seed samples collected in the final two botanical collection trips in February and March 2019 have been given sufficient time to germinate (some species can take over a year to germinate), until the maximum possible number of herbarium specimens collected through the project have been identified to the species level (a process that could take some years to complete due to extensive taxonomic revisions currently underway within many Malagasy plant genera) and also until the survival post-plantation of all the species currently being propagated at the Ivoloina nursery is assured. However, at this early stage, we are confident that we are online to achieve this outcome of increasing the number of Malagasy plants in ex-situ conservation from 2,100 to 2,600 species.

With respect to the second indicator, due to our training and subsequent coaching, ten young Malagasy contributed to reducing the risk of extinction of Malagasy plant species (see the preceding two paragraphs). This target has thus been fully attained. Evidence of the value of this capacity building is that, post project, 8 of these people have found employment that makes use of the skills acquired during their training.

3.3 Impact: achievement of positive impact on biodiversity and poverty alleviation

The agreed impact included on the application form was ‘Loss of Malagasy plant diversity avoided through ex-situ conservation’. At the end of this project a total of 528 species of native Malagasy plants originating from highly threatened forest fragments in the Ivoloina and Ifontsy

river valleys have been conserved *ex-situ* either as growing plants at Parc Ivoloina or in seed banks. The full list of conserved species can be downloaded at bottom of the DI webpage at https://www.madagascarfaunaflora.org/darwin-initiative.html

There is the possibility that some of the saved plant species have important commercial or medicinal value (see section 4.3).

It is premature to claim that the subpopulations from which these seed collections were collected have now been lost due to habitat destruction, but if this has not already occurred then it is certain, if current trends continue (as seems likely), that such loss is imminent. Indeed, it is likely that without immediate proactive intervention, all of the forest fragments sampled in this project will have been destroyed in the next decade. As a result of this project we have identified some forest fragments of particular botanical interest that could be targeted for follow up research and conservation activities to assess the potential of setting up community-managed protected forests such as that found at Ampasina (see Section 2). We are currently looking for funding to facilitate such follow-on work and hope that, at some time in the future, the botanical diversity captured by this present DI project can help provide the required plant resources to restore and enlarge these native forest fragments in this highly degraded part of the country. In this way, the groundwork achieved through this present project could, in the future, contribute to preserving and restoring vital ecosystem services for the local population.

Through the project 10 young Malagasy people have been given the opportunity to have successful careers, giving them the long-term capacity to support themselves. Importantly for poverty alleviation, we achieved gender equality in the hiring of both the botanists and the horticulturalists (see Section 4.4).

In addition, through the course of the project 654 Malagasy people were employed in some capacity, being paid a total of approximately 103,847 GBP. This represents significant employment generation for the duration of the project in a largely rural setting with few employment opportunities (see Section 4.3).

4 Contribution to Darwin Initiative Programme Objectives

4.1 Contribution to Global Goals for Sustainable Development (SDGs)

1. No poverty: this project made a contribution to this goal by providing financial compensation to a total of 654 Malagasy people. We are confident that all the ten young Malagasy we trained as field botanists and conservation horticulturalists will be able to base successful careers on this training, and eight have already done so.
4. Quality Education: the project provided high quality training and coaching for ten young Malagasy horticulturalists and field botanists and also for the MFG Botanical Conservation Agent. In addition, the project staff hosted 8 events aiming to promote environmental awareness for a total of 1,189 students and other members of the local community (for details see Annex 7.13, and Annex 7.1, photo 12), and provided six multi-day training workshops in best practice for propagating native trees for a total of 106 nurserymen/women from other organisations (for summary see Annex 7.14).
5. Gender Equality: the project has comprehensively demonstrated that females can be skilled and competent field botanists and horticulturalists – two posts that in Madagascar have traditionally been regarded as male domains.
15. Life on Land: to date the project has conserved seed samples from 528 plant species living in doomed forests. Without this intervention, this diversity would certainly have been lost. The young Malagasy who were developed as horticulturalists and field botanists represent an important advocate and resource for future plant conservation interventions in Madagascar.
17. Partnerships for Goals: this project has established an effective and trusting partnership between diverse institutions: MFG, MBG, RBG-Kew, SNGF, and PBZT. This collaboration will continue in the execution of similar work for at least two more years. We were particularly pleased to develop a new and unanticipated partnership with the extraordinary grass-roots association “Lovasoa” that is endeavouring to conserve the Ampasina Forest.

4.2 Project support to the Conventions or Treaties (CBD, CITES, Nagoya Protocol, ITPGRFA)

This project directly responded to one of the three main goals of the CBD i.e. the conservation of biological diversity. Of particular relevance is Target 8 Global Plant Conservation Strategy that is linked to the Convention after it was adopted by the Conference of Parties in 2002. This 16-point plan aims to slow the rate of plant extinctions around the world by 2020. Target 8 of this Strategy states *at least 75 per cent of threatened plant species in ex situ collections, preferably in the country of origin, and at least 20 per cent available for recovery and restoration programmes.*

The main mechanism whereby the goals of the CBD are achieved is through the development and the implementation of National Biodiversity Strategies and Action Plans (NBSAPs). Madagascar's NBSAP includes as Action 12.1 "*Mettre en œuvre des programmes in- situ et ex-situ de conservation et de rétablissement des populations d'espèces cibles concernées*", which translates as "Implement in situ and ex-situ conservation and recovery programs for target species populations".

4.3 Project support to poverty alleviation

This project was conceived to maximise the participation of the Malagasy people in Madagascar and in total 15 Malagasy received regular monthly salaries, at various points over the lifetime of the project, for their contributions to project implementation (3 senior staff, 4 field botanists, 7 nurserymen/women, 1 guardian). Of these, the field botanists and nurserymen/women developed marketable skills as a result of the project on the basis of which eight, to date, have succeeded in developing viable careers. Equal numbers of men and women were trained and hired for the field botany and horticulture components of the project (see Section 4.4) meaning that Millennium Development Goal #3 to promote gender equality and empower women was met.

In addition to the salaried staff, ca.436 local people received daily compensation for their services as guides, porters, cooks and seed collectors during field work, and 186 as day labourers either to help transport goods for the nursery or for the tree plantations, several individuals being hired on multiple occasions. When working in remote locations away from home, meals were also provided for the day labourers as an added benefit. The total sums distributed through daily compensation were significant and, although we can provide no supporting evidence, were likely important to the beneficiaries who are among the poorest members of society living in areas of extremely low employment. This project has thus contributed to addressing Millennium Development Goal #1 to eradicate extreme poverty and hunger.

The creation of skilled nurserymen/women is particularly significant with respect to poverty alleviation because the country urgently needs such people if natural capital is to be restored to Madagascar's vast areas of degraded and minimally productive land. It is conceivable that among the species conserved by this project will be those of economic significance that could contribute to the future development of the country including, for example, precious wood species, rosewoods and ebonies, that could potentially be grown in commercial plantations. It is noteworthy that among the species conserved *ex-situ* at Parc Ivoloina were 24 species of ebony, two of which are new to science, and 2 species of rosewood. It is also likely that some of the species conserved have significant traditional medicinal uses, which is particularly relevant in Madagascar where so few people can afford pharmaceutical medicines and the use of natural remedies for treating illness is so prevalent.

Finally, this project has directly helped to address Millennium Development Goal #8, which is to develop a global partnership for development. This project linked international organisations based in both the UK and the USA with those in Madagascar to work together to provide lasting solutions for biodiversity conservation in Madagascar and, through the actions listed above, have made a positive contribution to development.

4.4 Gender equality

As planned, the project selected, trained and coached equal numbers of young women and men as field botanists (2:2) and horticulturalists (3:3). The trainees of both genders were treated equally and both men and women performed equally well albeit with a tendency for some of the women to gravitate to less physically arduous tasks. This situation caused some friction initially

between the men and women on the horticultural team due to the men being required to do more of the heavy lifting occasionally required through their work. However, compromises were sought and the different strengths of the various team members emphasised and, very quickly, cohesive teamwork developed.
Both botany and horticulture are careers that have been traditionally viewed as predominantly for men in Madagascar so the training and hiring of equal numbers of men and women is particularly relevant to addressing this imbalance and creating a paradigm shift with regards to the perception of traditional roles within Madagascar. 4 of the 8 people that have so far managed to secure ongoing careers in their trained field are female so the project has successfully contributed to directly addressing the Millennium Development Goal for poverty alleviation and the improvement of quality of life #3, which is to promote gender equality and empower women. It must be recognised that it has proven more difficult to find appropriate post-project employment for the women compared to the men. This is because some of the female ex-trainees wanted to settle down and have children while others did not want to accept job offers at remote rural locations where they fear for their security as lone women. For the female field botanists in particular this will be an ongoing consideration and one for their personal evaluation with each potential post that becomes available. It is important, nonetheless, to continue to provide equal opportunities for training and for employment as has been the case throughout this project.

4.5 Programme indicators

- **Did the project lead to greater representation of local poor people in management structures of biodiversity?**

No, however, as a result of the project we plan to follow up by investigating the possibility of setting up community-managed protected forests in a few areas of particular botanical interest (identified through the course of the project), where the local community has expressed an interest in protecting the remaining forest in their area.

- **Were any management plans for biodiversity developed and were these formally accepted?**

No

- **Were they participatory in nature or were they 'top-down'? How well represented are the local poor including women, in any proposed management structures?**

N/A

- **How did the project positively influence household (HH) income and how many HHs saw an increase?**

15 HHs through long term salaries,17 HH through short term contributions to salaries, and 622 HHs though compensation to day labourers

- **How much did their HH income increase (e.g. x% above baseline, x% above national average)? How was this measured?**

We did not collect baseline information on the income of project beneficiaries (it would be intrusive to do so) so therefore it is difficult to respond to this question. However, the compensation received by the 15 staff members would constitute the major source of income for their respective households (most likely over 50% on average) whereas the compensation received by the 622 day labourers, while apparently modest, would in fact have been highly significant to some (doubling their income for a given month) particularly when the employment we offered coincided with times when harvests had been exhausted. This was particularly relevant after the passage of Cyclone Ava on 5th January 2018, which destroyed many crops in the area.

4.6 Transfer of knowledge

As planned, the project did not endeavour to transform the training offered into formal qualifications because this would have required significant additional expenditure without improving the quality of the knowledge and skills transferred nor the status of the training provided. We are confident that the training provided in field botany and horticulture was of a high standard and the names of organisations providing this training (predominantly Missouri

Botanical Garden and Royal Botanic Gardens, Kew) will be sufficient to ensure that the young Malagasy recipients of this training and experience will be favoured in appropriate job applications. Equal numbers of men and women completed the comprehensive training programme provided through this project.

In total, through the project, 2077 herbarium specimens were collected in replicate. These specimens themselves are a source of knowledge and, like books in a library, can reveal much to those who consult them. A replicate of each specimen was lodged in Madagascar's national herbarium at PBZT, and four other international herbaria where they are freely accessible to the World's botanists. The collection information associated with each herbarium specimen was entered in the freely available electronic botanical database TROPICOS, within the Catalogue of the Plants of Madagascar (http://www.tropicos.org/Project/Madagascar). An example of this information for herbarium specimen RBM128, presented as a screen shot from the webpage, is presented in Annex 7.11. The 2077 DI specimens represent 19.8% of the total number of 10,461 herbarium specimens from Malagasy plants that were databased into TROPICOS by all projects combined during the 3-years of the project. Thus the DI project made a significant contribution to our knowledge of the Malagasy flora.

During the project the DI nursery team provided training in various aspects of plant propagation work to a total of 106 nursery men and women associated with other projects (see Annex 7.14). In addition, gained knowledge was shared through the course of the project by the means outlined in Section 7. In addition, an educational trail was developed to showcase the DI work at Parc Ivoloina, including informative panels explaining the project goals and individual tree identification signs to highlight species of particular interest.

4.7 Capacity building

Alex Mamisoa (Malagasy, male), initially Manager of Conservation Horticulture for the present project was promoted to overall Project Coordinator following the departure of the first Project Coordinator (due to the relocation of his family to another part of Madagascar). Alex has now had his contract extended at Parc Ivoloina and will help coordinate forest restoration activities at Betampona Strict Nature Reserve, MFG's other main site of intervention in eastern Madagascar. Alex's superb skills as a horticulturalist, an organiser and people manager were recognised through the course of his work on the DI project and will now being put to good use in other aspects of MFG's conservation programme. Alex has been invited to head horticulture training sessions for a number of independent groups on the basis of his DI achievements (see Annex 7.14). Project-trained botanist, Sandy Rasoanindriana (Malagasy, female) was retained at the end of her botanist's contract and promoted to become the project plant database manager for the remaining duration of the DI project. Chris Birkinshaw (foreign, male) has been invited to join the Ecological Restoration Alliance of Botanic Gardens and to speak on the Darwin Initiative project at the World Congress of the Society for Ecological Restoration at Cape Town in September 2019.

The project resulted in significant improvements to infrastructure at both Parc Ivoloina and SNGF. At Parc Ivoloina one existing plant nursery was rehabilitated and one large new nursery was installed (see Annex 7.1, Photo 8.). Both these nurseries were built to high standards with raised propagation tables and rooves and walls of shade netting. The second nursery also boasts a pumped water source. The project also provided MFG with equipment for camping and botanical inventory that is now facilitating this organisation's on-going conservation work. Aspects of the improved design of the newly-developed plant nurseries at Parc Ivoloina have now been transferred to MFG's community-run plant nurseries around the Betampona Strict Nature Reserve. The capacity of SNGF to bank seed samples was improved through the provision of various materials and equipment as listed in Annex 7.12 as well as through institutional support for their operating costs during the first two years of the Darwin Initiative project (see Annex 7.2).

5 Sustainability and Legacy

This project has two main legacies: the ex-situ conservation collections for plants and the young Malagasy field botanists and horticulturalists who were trained by this project. To reap the full benefits of this project some activities will be necessary for the next two years – in particular, the seedlings remaining in the nursery will need to be planted out into the Parc; plants already planted at Parc Ivoloina will benefit from some on-going care to prevent those that are slower growing from being smothered by the invasive herb *Dicranopteris linearis*, and important species discovered by the botanists but not yet sampled for seeds should be relocated and seed samples collected and propagated. Fortunately, we have accessed several additional sources of funding that will allow this work to go ahead and enabling two DI horticulturalists to be retained along with Alex Mamisoa, Manager of Conservation Horticulture and DI Project Coordinator, for a further two years.

We are invested in seeking further resources so that the ex-situ plant conservation work at Parc Ivoloina will be able to become a permanent activity – albeit dependent on the ongoing securing of funds from different funding sources. Vigilance will be required to ensure that the collections are secure from wildfires that occasionally threatened Parc Ivoloina. Most specifically MFG will need to conceive and implement a plan to reduce the risk of wild fires accessing the site. Additionally, we are now seeking follow-on funds to help set up community-based conservation of some of the larger and more botanically interesting forest fragments identified though the DI project. The on-going relationship between RBG-Kew and SNGF should ensure that the seed banks remain well maintained.

We are delighted that all the ten Malagasy field botanists and horticulturalists enjoyed their work as part of this DI project, and that eight of them have now found employment that makes full use of the skills and knowledge that they acquired through the project. These people, in the different parts of Madagascar where they now work, can all make a contribution to the discovery and conservation of the Malagasy flora. We are hopeful that one or two may become leaders in their fields.

On the basis of MBG's experience with this project, Chris Birkinshaw was able to secure funds from two sources for *ex-situ* plant conservation initiatives elsewhere in Madagascar. Specifically, with these funds, field gene banks (effectively mini botanical gardens in semi-natural settings) are now being established in association with six of the protected areas that are being managed by MBG. At each site, MBG's local capacity will be valorised to collect vouchered seed samples from unprotected forests in the landscape surrounding the designated protected area and then propagated at village nurseries, with the objective of planting the resultant seedlings, each tagged with their voucher collection numbers, within secure areas adjacent to the protected area. More information about this project, that is currently focused on rosewoods and ebonies, can be found here: http://www.tropicos.org/Project/Madagascar

6 Lessons learned

The following innovations made during the project contributed to its success.

1) In Year 2, work was organised to enable one of the horticulturalists, in rotation, to join each of the fieldtrips organised by the botanists. This innovation was appreciated by both parties and was observed to have the following positive effects: removing barriers between the field botany and horticulture staff and thereby creating a feeling of one team working for a shared objective; providing the horticulture staff with a full understanding of the need for the project (i.e. seeing for themselves the highly degraded landscape) and thereby enabling them to speak, from their own experiences, to justify their work during educational events; and providing the horticulture staff with an understanding of field botany that may serve them well when the seek employment. Similarly, the botanists sometimes helped in planting the seedlings into the park. The general lesson to be derived from these experiences is the importance of blurring rigid job descriptions to promote good team work.

2) We are fortunate that our Manager of Conservation Horticulture, Alex Mamisoa, is one of Madagascar's most accomplished horticulturists. His work to prepare the sites destined to host the seedlings propagated by the project included an array of treatments including, for example, removal of alien trees; control of the smothering fern *Dicranopteris linearis*, use of green

manures, temporary provision of shade structures for seedlings, and investment in watering seedlings should a period of drought immediately proceed plantation. In the original proposal we had not anticipated the importance of site preparation in enabling the survival and growth of seedlings. We are fortunate that Alex showed his initiative in this respect. The general lesson here is to provide all staff members reasonable freedom to innovate with the objective of improving their work.

3) A tantalising aspect of this project was that a number of very important plant species, including a number of species that were new to science, were discovered by the field botanists, but could not be sampled for seeds during the project's duration because they were not fruiting at the time of the field visits. Previously follow-up funding from the Darwin Initiative might have been accessible to enable the collection of seed samples from these plants but sadly, this funding instrument is no longer available. It is fortunate therefore that we have been able to access funds from alternative donors to permit this critical follow-up work.

Although we are proud of our work in this project, mistakes were made. The most important of these are listed as follows.

1) In our original proposal we failed to recognise that cyclone impact might be among the risks faced by the project. On 5 January 2018 Cyclone Ava passed close to Parc Ivoloina and brought with it heavy rains and strong winds. Both these phenomena caused seedling injury and death in the nurseries and also to seedlings already planted-out in the park. In the nursery, the heavy rain caused seeds and seedlings to rot while the wind literally blew away newly pricked-out seedlings. The winds also caused the shade netting to collapse, which then damaged seedlings by flapping around in the winds (Annex 7.1., photo 10). The seedlings that had been planted-out where literally crushed by the fall of debris. In total 23.7% of seedlings in the nursery were killed by the cyclone, while 9% of the seedlings already planted-out were killed. Seedling death in the nursery could have been reduced if the young plants had been displaced below their propagation benches prior to the arrival of the cyclone. The damage to the nursery infrastructure was quickly repaired thanks to a joint effort by the entire Darwin Initiative team; and two weeks after the event an uninformed visitor would not have known that the nursery had suffered from such a cataclysmic event. The team were better prepared for subsequent cyclones and were able to minimise damage as a result.

2) Sometimes a species was represented in the nursery by just a few seedlings yet these important plants were treated in the same manner as species that were much better represented in the nursery. As a future improvement to this work it would be worthwhile distinguishing these very important plants from those that are less important and providing them with greater care in the nursery and when they are planted out into the Parc – for example by ensuring that they are planted into the most desirable locations where the soil is optimal and there are some shading shrubs.

3) The accession database contains some 77 fields, and actualising the data consumed an expectedly large proportion of the horticulturalists' time. Arguably some of these fields are unnecessary and the datasheet could have been streamlined thereby releasing staff for other tasks.

6.1 Monitoring and evaluation

There were no major changes to the project design and we did not request any changes to the log frame. The monitoring and evaluation plan was fit for purpose and the indicators truly indicative and valuable for informing adaptive management. However, the time required for specialist identification of the voucher herbarium specimen means that even until this moment we do not know exactly how many species were sampled in this project. However, it should be noted that specialists are located in diverse institutions throughout the world and provide their identification services at no cost, and therefore little can be done to hasten this process. Indeed, it is likely that specimens for which our botanists have provided a preliminary identification may be identified differently by specialists at some time in the future. During the project period there was no external evaluation of the project however 6-monthly technical reports were submitted to the Malagasy Government as part of the process of requesting new research permits. We received no feedback on these reports and our permits were always renewed.

6.2 Actions taken in response to annual report reviews

The review of our work at the end of Year 1 suggested that the stand-alone identity of this DI project was not immediately obvious. In order to respond to this observation, we have made a large effort this year to promote the DI activities as independent of any project partner's individual programmatic activities. These efforts are detailed in Section 7. The first annual review was shared with the main project partners. Following the submission of our Year 2 report we received no further feedback.

7 Darwin identity

We publicised the Darwin Initiative in the following ways.

Social media: A dedicated page detailing the DI project was created on the MFG website : (http://www.madagascarfaunaflora.org/darwin-initiative.html). It was decided not to create a stand-alone website for the DI project as it would not be able to be maintained and updated beyond the project's three-year duration. Also the creation of this dedicated page on the MFG website enabled the project to be easily discovered by the large number of people who are already familiar with the MFG website. The webpage was regularly updated using a table that tracked progress and highlighted important discoveries or achievements. This page carried a link to the project's twitter account (@ DI_gasyplants) that during the project carried 33 tweets. The Darwin Initiative is acknowledged as appropriate in these tweets.

Events: In July 2018 we organised an official launch of the DI nursery attended by representatives of the local and regional government as well as senior staff from 11 international zoos (who were attending the MFG annual meeting at Parc Ivoloina at the time). The Ambassador for Great Britain was invited to oversee the ceremony but was otherwise engaged overseas at the time. Instead the British Consul for Madagascar, Michel Gonthier, led the proceedings (see Annex 7.1, photo 5). The Ambassador to Great Britain later made an informal visit to see the project's activities, and shared a complimentary tweet about his visit (@PhilBoyleFCO). In March 2019 representatives of local and regional government and leaders from the communities where our field botanists had worked were invited to a restitution of the project at Parc Ivoloina. Following formal presentations, the group were guided along the newly installed educational trail (Annex 7.1., photo 13).

Signage: Acknowledgement of DI support and the DI logo was included in presentations, signage (one sign for each of the nurseries and one sign at the start of the educational trail), and on the team T-shirt (Annex 7.1., photo 5).

Scientific communications: The Darwin Initiative Project has been shared by means of oral presentations to groups of both scientists and conservationists. In May 2017 Chris Birkinshaw presented the project to 21st Association pour l'Etude Taxonomique de la Flore d'Afrique Tropicale International Congress in Nairobi; and in March 2018, Chris provided a similar presentation to a group of 14 conservation managers originating from Madagascar, Seychelles, Mauritius and the Comoros during a workshop on Conservation Management organised by the NGO Vahatra and funded by the Critical Ecosystem Partnership Fund. On both occasions the Darwin Initiative was acknowledged as the source of support for the work described. At least seven plant species new to science were discovered during this work and these will be named by taxonomists in the near future. It is possible that one of these could be given a name acknowledging the importance of the DI support in enabling its discovery.

The Darwin Initiative is well known in Madagascar. In part this is because the programme has a long history of funding conservation work here and in part because of the personal interest in conservation of recent British Ambassadors. The RFA Round 25 attracted five Stage 1 proposals.

Popular press: During the project, MFG's own Malagasy newsletter, *Bitsik' Ivoloina*, included three articles concerning the Darwin Initiative Project and the project was discussed during one of MFG's regular scheduled radio emissions; *Bitsiky ny Ala Atsinanana*. The official opening of the Darwin Initiative nursery (mentioned above) was filmed and aired on a popular local Malagasy television channel. Darwin Initiative was credited in each instance for funding the activities discussed.

8 Finance and administration

8.1 Project expenditure

Project spend (indicative) since last annual report	2018/19 Grant (£)	2018/19 Total actual Darwin Costs (£)	Variance %	Comments (please explain significant variances)
Staff costs (see below)			-0.4	-
Consultancy costs			-	-
Overhead Costs			0	-
Travel and subsistence			-21.7	Significant savings were made through the predominate use of public transport rather than hire of private vehicles
Operating Costs			+8.3	-
Capital items (see below)			-8.2	-
Others (see below)			+9.7	-
TOTAL				

Staff employed (Name and position)	Cost (£)
Karen Freeman, Project Leader	
Chris Birkinshaw, Director of Field Botany	
Sahondra Rasoaharisoa, MFG accountant	
Alexandre Mamisoa, Project Coordinator	
Mickaela Tahina Malalasoa, Horticulturalist	
Lalaina Nina Mandimbiosa, Horticulturalist	
Sandra Bodotahiana Rakotomanana, Horticulturalist	
Platini Joelimanana, Horticulturalist	
David Rajaonarivelo, Horticulturalist	
Jeannot Philemond, Horticulturalist	
Harisandy Rasoanindriana, Botanist and Database Manager	
Chanu Jems Antoine, Guardian	
Narindra Ramahefamanana, MBG Conservation Co-ordinator's Assistant	
Noro Ravololomanana, MBG Junior Scientist	
Various day labourers (weekend cover for guardians etc.)	
TOTAL	

* Note: difference from table above due to exchange rate conversion rounding errors as only showing 2 decimal places

Capital items – description	Capital items – cost (£)
Ceramic trays for SNGF Thermometers for SNGF Glass storage jars for SNGF Vernier calipers and sprayer for SNGF	
TOTAL	

* Please note that although there was no capital expenditure this year for MFG, MBG or RGB-Kew, there were some equipment items purchased for Silo de Graines National (SNGF) for the functioning of the Malagasy national seed bank as listed above. There are further additional equipment items for SNGF listed under Operating Costs. The reason for this is that a contribution to the functioning of the SNGF seedbank was listed in all three years for this project under Operating Costs but in this final year some replacement equipment was required to ensure continued functioning of the seed bank and preservation of the submitted seed. It was felt that MBG, with 30 years' experience in purchasing botanical equipment were best placed to buy the equipment on SNGF's behalf.
The costs listed under Operating Costs are detailed here:
Induction plate, microwave, water filter, blender, pots: £379.09
Laptop for record keeping: £616.05
Secateurs, saws, handle extension, sprayer: £354.08

Other items – description	Other items – cost (£)
Consumables for field work (batteries, medicines etc.) Gas for plant specimen drying Materials for plant nursery (soil, posts, tools, sand etc.) Consumables for SNGF seed bank (plastic boxes, bowls, buckets etc.)	
TOTAL	

* Note: difference from table above due to exchange rate conversion rounding errors as only showing 2 decimal places

8.2 Additional funds or in-kind contributions secured

Source of funding for project lifetime	Total (£)
MFG (Organising visits of Saturday School children to project, coverage on radio-shows, MFG newsletters, website, Twitter and Facebook accounts)	
10% of MFG Forestry Station Manager salary for oversight of plantation sites x 3 years	
Hire of MBG camping and collecting equipment while waiting for DI shipment of equipment	
Staff time MBG St Louis for ordering and shipment of equipment	
Staff time MBG St Louis for horticultural expertise and trial integration of accession database into Living Collection Monitoring System	
Staff time MBG St Louis for banking of silica gel leaf samples: supervision of 2 volunteers for 6 months	

Private Donor via MBG (compensation for lead field botanists and 6 trainee field botanists during fieldwork in February and March 2019 to collect additional seed samples)	
RBG Kew Millennium Seed Bank costs	
TOTAL	

Source of funding for additional work after project lifetime	**Total (£)**
Mohamed bin Zayed Fund for Nature Conservation (for targeted *ex-situ* conservation of all sub populations of *Dracaena umbraculifera*)	
Private donor (for targeted *ex-situ* conservation of all sub populations of *Dracaena umbraculifera*)	
Association of Zoological Horticulture (for targeted ex-situ conservation of all sub populations of *Dracaena umbraculifera*)*	
Friends of MBG (to enable functioning of Parc Ivoloina nursery for an additional 12 months)	
TOTAL	

* Note: a further application for $7470 has been submitted to the Association of Zoological Horticulture for further follow up conservation work on four other new plant species that were identified through the DI project and are known to exist only in a small number of the unprotected forest fragments the project targeted. A decision is expected by early September 2019.

8.3 Value for Money

This project truly represented exceptional value for money because *ex-situ* conservation of plants as living plants in Madagascar is considerably less expensive than similar work overseas. This is because personnel costs are much cheaper in Madagascar compared to comparable costs in the UK or in other developed countries. Value was also provided by using public transport were possible and never travelling by air. In cases where 4-wheel drive vehicles were required to access difficult areas not accessible by public transport, MFG or MBG vehicles were used rather than hiring vehicles at a far higher daily rate from independent car hire companies. In this project we estimate that 528 species were conserved ex-situ for a cost of £235,894, this translates into expenditure of £447 per species. This is very good value valued compared to *ex-situ* plant conservation work in developed countries that can cost tens or even hundreds of thousands of pounds per species.

Additionally, excellent value for money was achieved through this project thanks to the extensive infrastructure in place both at MFG and MBG's Madagascar headquarters. This was experienced in many different forms but one particular example includes the renovation of MFG's *Gite Tranobe* at Parc Ivoloina to house the project botanists through both the 3-month initial intensive training and throughout the duration of the field project. Had it been necessary to build a house from scratch or to rent a property in Toamasina and provide transport to and from the park every day, the costs would have been far higher as well as a lot of time being lost, which would have severely impacted project productivity. Similarly, MBG allowed their Madagascar headquarters to be used for storage, sorting, identification and preparation of specimens for shipping overseas as necessary for final identification to species level. Again, this saved a great deal of money through not having to hire a dedicated building to facilitate this work, which was vital to the project.

Another example of significant savings being made was through the generous support of MBG to carry out the extremely arduous process of researching, ordering and, most onerously, organising the shipping and importation into Madagascar of the majority of the DI project equipment. When ordering airpots (special plant pots that promote strong root growth) from the UK manufacturers, MFG were able to secure their purchase at the production cost rather than the usual commercial purchase cost by explaining the important conservation goals of the project. For all required purchases, efforts were made to secure the best value for money by using trusted

suppliers as far as possible. Both MFG's and MBG's long standing establishment in Madagascar (25 and 30 years respectively) have allowed us to develop good relationships with local businesses, suppliers and professionals of many trades, allowing us to make good judgements of where the best value for money can be obtained.

Annex 1 Project's original (or most recently approved) logframe, including indicators, means of verification and assumptions.

Project summary	Measurable Indicators	Means of verification	Important Assumptions
Impact: Loss of Malagasy plant diversity avoided through ex-situ conservation (Max 30 words)			
Outcome: Newly-trained Malagasy field botanists and nurserymen/women conserve the genetic diversity of threatened sub-populations of 500 endemic Malagasy flowering plant species as growing plants or in seed banks (Max 30 words)	0.1 Number of Malagasy plant species preserved using ex-situ conservation measures increases from baseline of ca. 2100 species (the number of species actually conserved ex-situ in the MSB and Parc Ivoloina) to ca. 2600 species 0.2 Ten newly-trained Malagasy field botanists and nurserymen/women intervene effectively to reduce the risk of extinction of their flora through ex-situ conservation	0.1 Report (based on compilation of data from accession databases) listing species covered for the first time by ex-situ conservation measures as a result of this project 0.2 End of project independent evaluation of the strengths and weaknesses of the newly trained field botanists and nurserymen/women	- Most Malagasy plants can be either conserved long term in seed-banks or have seeds that can be germinated and grown thereby allowing conserved as growing plants - Young Malagasy are motivated to invest their career in the conservation of the Malagasy flora
Outputs: **1**. *Training and capacity building provided to enable four young Malagasy men/women to organise field trips, conduct botanical inventories, and collect high quality seed samples for ex-situ conservation*	1.1 By end Year 1, four field botanists are able and independently capable of making vouchered, genetically diverse, and high quality seed samples of endemic Malagasy plants 1.2 The field botanists selected for training have an equitable distribution of genders	1.1 Evaluation report elaborated by Manager of Field Botany of competence of each trainee and self-evaluation of competence by each trainee 1.2. Report on gender distribution of trainees	- Candidates for training are available who have the physical attributes and character to cope with the sometimes harsh conditions of fieldwork in Madagascar
2. *Training and capacity building provided to enable six young Malagasy men/women the skills necessary to propagate and nurture native Malagasy plants*	2.1 By end of 3-month formal training six nurserymen/women are independently capable of propagating seeds of most endemic Malagasy plants and then nurturing resultant seedlings	2.1 Evaluation report elaborated by Manager of Conservation Horticulture of competence of each trainee and self-evaluation of competence by each trainee	- Candidates for training are available who have the physical attributes and empathy for plant life required by excellent horticulturalists.

	with <30% mortality and by end Year 1 six nurserymen/women are independently capable of propagating seeds of all endemic Malagasy plants and then nurturing resultant seedlings with < 10% mortality 2.2 The nurserymen/women selected for training have an equitable distribution of genders	2.2. Report on gender distribution of trainees	
3. *Vouchered and genetically diverse seed samples collected for at least 500 endemic Malagasy species from remaining native forest fragments within Ivoloina-Ifontsy River Valleys*	3.1 By end Year 1 and end Year 2 genetically diverse seed samples are collected from a total of 200 and 500 vouchered, endemic plant species respectively and collection information data-based	3.1 Download of collection information (voucher herbarium specimens) from TROPICOS database	-Specialist identification of voucher specimens can be obtained during the project's duration
4. *At least 500 vouchered, genetically-diverse, endemic Malagasy flowering plant species conserved ex-situ*	4.1. During each monitoring period seed sample germination, seedling survival, and survival of young plants at Parc Ivoloina all >80% 4.2. By end Year 2 and Year 3 respectively, 200 and 500 genetically distinct sub-populations of endemic Malagasy flowering plant species growing in final planting locations at Parc Ivoloina or included in the MSB and its national partner seed bank at SNGF	4.1. Download from Living Plant Monitoring System database from Parc Ivoloina 4.2. Download from Living Plant Monitoring System database from Parc Ivoloina and Accessions Register from the MSB and SNGF	-Nursery teams able to retain high standards at times when the field teams collect large numbers of samples (phenological periodicity of work)

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

1.1. Project Leader, Director of Field Botany and Field Botany Manager select four trainees (most former graduates of ISSEDD)

1.2. The Project Leader obtains the required seed collection permits

1.3 Director of Field Botany and Field Botany Manager organises 12-month training course (3-month formal training and 9 months coaching with experienced field botanists)

2.1. Project Leader and Manager of Conservation Horticulture select six trainees

2,2, Manager of Conservation Horticulture expands and improves the nursery at Parc Ivoloina

2.3. Project Leader and Manager of Conservation Horticulture conceives and implements 3-month formal training course and then the Manager of Conservation Horticulture coaches the trainees for the remainder of the project

3.1. Two teams of field botanists organise expeditions to unprotected forest fragments in the Ivoloina-Ifontsy valleys and there collect vouchered seed samples of Malagasy plants

3.2. Seed samples of species considered orthodox sent to the SNGF Seed Bank and the Millennium Seed Bank

3.3. Seed samples of species considered recalcitrant sent to Parc Ivoloina for propagation

3.4. Voucher herbarium specimens processed so that replicates are both deposited at Madagascar's national herbarium and exported to international herbaria for expert identification

3.5. Data from voucher herbarium specimens data-based

4.1. Manager of Conservation Horticulture at Parc Ivoloina enters collection information for each seed accession into Living Plant Monitoring System and then updates history of each accession within the System throughout project and beyond

4.2. Head of accessions at the SNGF seed bank and the Millennium Seed-bank enters collection information into their respective accessions systems

4.3. Manager of Conservation Horticulture at Parc Ivoloina and six nurserymen/women propagate seeds and nurture seedlings, and label all accessions with unique codes linked to LPMS

4.4. Manager of Conservation Horticulture identifies appropriate planting locations for the seedlings within Park Ivoloina and directs planting out and labelling

4.5. Newly planted plants weeded until fully established

4.6. Creation of educational display (panels and labelling) at Parc Ivoloina of some of the interesting plants included in the project

4.7. Sharing results with local stakeholders through an open day at Parc Ivoloina for representatives of the communities where we worked

4.8. Organising visits of all Saturday school children to visit the project, coverage on radio show, MFG newsletters, website, Twitter and Facebook accounts

4.9. Publishing results in peer-reviewed journal

Annex 2 Report of progress and achievements against final project logframe for the life of the project

Project summary	Measurable Indicators	Progress and Achievements
Impact: Loss of Malagasy plant diversity avoided through ex-situ conservation		In total, assuming that all currently unidentified species have not previously been collected, 528 species of native Malagasy plants originating from highly threatened forest fragments have been conserved ex-situ either as growing plants at Parc Ivoloina or in seed banks. Many of these species have been collected from multiple locations.
Outcome Newly-trained Malagasy field botanists and nurserymen/women conserve the genetic diversity of threatened sub-populations of 500 endemic Malagasy flowering plant species as growing plants or in seed banks	0.1 Number of Malagasy plant species preserved using ex-situ conservation measures increases from baseline of ca. 2100 species (the number of species actually conserved ex-situ in the MSB and Parc Ivoloina) to ca. 2600 species 0.2 Ten newly-trained Malagasy field botanists and nurserymen/women intervene effectively to reduce the risk of extinction of their flora through ex-situ conservation	0.1. In total 953 seed samples were collected. Of these 856 were sown and 260 sent to SNGF for conservation in seed banks. Among the samples sown, to date, at least some seeds have germinated from 681 samples. These samples include 467 species. In total, 528 species were conserved either in seed banks or as growing plants at Parc Ivoloina. 0.2. The outcome described above was achieved by four newly trained Malagasy field botanists and 6 newly trained Malagasy horticulturalists.
Output 1. Training and capacity building provided to enable four young Malagasy men/women to organise field trips, conduct botanical inventories, and collect high quality seed samples for ex-situ conservation	1.1 By end Year 1, four field botanists are able and independently capable of making vouchered, genetically diverse, and high quality seed samples of endemic Malagasy plants 1.2 The field botanists selected for training have an equitable distribution of genders	1.1. Four competent young Malagasy field botanists trained. Evidence provided in Section 3.1. 1.2. Two male and two female field botanists were trained. Evidence provided in Section 3.1
Activity 1.1 Project Leader, Director of Field Botany and Field Botany Manager select four trainees (most former graduates of ISSEDD)		Completed Year 1
Activity 1.2. The Project Leader obtains the required seed collection permits		Completed in Year 1, with renewals in Year 2 and Year 3 (see Annex 7.6)

Project summary	Measurable Indicators	Progress and Achievements
Activity 1.3 Director of Field Botany and Field Botany Manager organises 12-month training course (3-month formal training and 9 months coaching with experienced field botanists)		Completed: formal training completed in Semester 1 of Year 1, followed by 21 months of coaching.
Output 2. *Training and capacity building provided to enable six young Malagasy men/women the skills necessary to propagate and nurture native Malagasy plants*	2.1 By end of 3-month formal training six nurserymen/women are independently capable of propagating seeds of most endemic Malagasy plants and then nurturing resultant seedlings with <30% mortality and by end Year 1 six nurserymen/women are independently capable of propagating seeds of all endemic Malagasy plants and then nurturing resultant seedlings with < 10% mortality 2.2 The nurserymen/women selected for training have an equitable distribution of genders	2.1. Six Malagasy trained and coached to become competent horticulturalists. Mortality of planted seedlings 29%. This mortality rate was higher than expected due in part to the loss of seedlings during Cyclone Ava and also due to the infertile and compact soils at the plantation sites. 2.2. 3 male and 3 female horticulturalists were trained (see Section 3.1).
Activity 2.1. Project Leader and Manager of Conservation Horticulture select six trainees		Completed in Semester 1 of Year 1.
Activity 2.2. Manager of Conservation Horticulture expands and improves the nursery at Parc Ivoloina		Nursery 1 complete in Year 1, Nursery 2 complete in Semester 1 of Year 2. In total the two nurseries could accommodate 15,000 seedlings.
Activity 2.3. Project Leader and Manager of Conservation Horticulture conceives and implements 3-month formal training course and then the Manager of Conservation Horticulture coaches the trainees for the remainder of the project		Training completed in Semester 1 of Year 1, and coaching continued to end of project.
Output 3. *Vouchered and genetically diverse seed samples collected for at least 500 endemic Malagasy species from remaining native forest fragments within Ivoloina-Ifontsy River Valleys*	3.1 By end Year 1 and end Year 2 genetically diverse seed samples are collected from a total of 200 and 500 vouchered, endemic plant species respectively and collection information data-based	3.1 At the end of the project 953 seed samples had been collected from ca. 528 species. However, it is likely that many of the seed samples are not very genetically diverse because in the remaining forest fragments there are often only a few mature (sometimes only one) individuals of a given species. The full database from which these quantities are derived can be

Project summary	Measurable Indicators	Progress and Achievements
		downloaded at the bottom of the DI webpage https://www.madagascarfaunaflora.org/darwin-initiative.html This indicator and the associated targets were well conceived although, in retrospect, we should have specified that genetically diverse samples would be collected when possible.
Activity 3.1. Two teams of field botanists organise expeditions to unprotected forest fragments in the Ivoloina-Ifontsy valleys and there collect vouchered seed samples of Malagasy plants		Completed: a total of 19 field trips were made.
Activity 3.2. Seed samples of species considered orthodox sent to the SNGF Seed Bank and the Millennium Seed Bank		Completed: a total of 260 seed samples were dispatched for seed banking
Activity 3.3. Seed samples of species considered recalcitrant sent to Parc Ivoloina for propagation		Completed: a total of 856 vouchered seed samples sown at Parc Ivoloina
Activity 3.4. Voucher herbarium specimens processed so that replicates are both deposited at Madagascar's national herbarium and exported to international herbaria for expert identification		Completed: without exception all seed samples were vouchered with herbarium specimens
Activity 3.5. Data from voucher herbarium specimens data-based		Completed: field information from all vouchers entered into the TROPICOS database
Output 4. *At least 500 vouchered, genetically-diverse, endemic Malagasy flowering plant species conserved ex-situ*	4.1. During each monitoring period seed sample germination, seedling survival, and survival of young plants at Parc Ivoloina all >80% 4.2. By end Year 2 and Year 3 respectively, 200 and 500 genetically distinct sub-populations of endemic Malagasy flowering plant species growing in final planting locations at Parc Ivoloina or included in the MSB and its national partner seed bank at SNGF	4.1. 79.5% of seed samples germinated, and 71% of planted seedlings survived until the end of the project. Evidence is provided at https://www.madagascarfaunaflora.org/darwin-initiative.html 4.2. At the end of this project seedlings of 265 species are growing at Parc Ivoloina and 194 species have been deposited in seed banks. Evidence is provided in the accession data base which can be downloaded at: https://www.madagascarfaunaflora.org/darwin-initiative.html

Project summary	Measurable Indicators	Progress and Achievements
Activity 4.1. Manager of Conservation Horticulture at Parc Ivoloina enters collection information for each seed accession into Living Collection Monitoring System and then updates history of each accession within the System throughout project and beyond		Currently the seed accession remains in an excel spreadsheet. This will be transferred into MBG's Living Collections Monitoring System in August 2019. A trial integration of our accession database into MBG's Living Collection Monitoring System has already been completed.
Activity 4.2. Head of accessions at the SNGF seed bank and the Millennium Seed-bank enters collection information into their respective accessions systems		Completed
Activity 4.3. Manager of Conservation Horticulture at Parc Ivoloina and six nurserymen/women propagate seeds and nurture seedlings, and label all accessions with unique codes linked to LCMS		Completed except for data upload into LCMS
Activity 4.4. Manager of Conservation Horticulture identifies appropriate planting locations for the seedlings within Parc Ivoloina and directs planting out and labelling		Completed
Activity 4.5. Newly planted plants weeded until fully established		Completed: all weeded plants weeded in Year 2 and again just before the end of the project in Year 3.
Activity 4.6. Creation of educational display (panels and labelling) at Parc Ivoloina of some of the interesting plants included in the project		Completed: one large information panel and 43 individual plant labels installed along an educational trail at Parc Ivoloina in Semester 2 of Year 3.
Activity 4.7. Sharing results with local stakeholders through an open day at Parc Ivoloina for representatives of the communities where we worked		Completed: restitution of project and inauguration of trail with 23 invitees in March 2019.
Activity 4.8. Organising visits of all Saturday school children to visit the project, coverage on radio show, MFG newsletters, website, Twitter and Facebook accounts		Completed: during the 3 years the project has hosted visits from 1,189 students, provided training in horticultural techniques for 106 Malagasy nurserymen/women, created a webpage dedicated to the project (https://www.madagascarfaunaflora.org/darwin-initiative.html), and maintained a twitter account that now has 33 posts.
Activity 4.9. Publishing results in peer-reviewed journal		Not completed: the results of this study will be published when we have 12-month seedling survival data from all the plants planted as part of the project. However preliminary results of the project were presented orally at the "Association pour l'Etude Taxonomique de la Flore d'Afrique Tropicale"

Project summary	Measurable Indicators	Progress and Achievements
		Congress in Nairobi in 2017 and a similar but updated oral presentation will be made at the Society for Ecological Restoration (SER) World Conference in Cape Town in September 2019.

Annex 3 Standard Measures

Code	Description	Total	Nationality	Gender	Title or Focus	Language	Comments
Training Measures							
1a	Number of people to submit PhD thesis						
1b	Number of PhD qualifications obtained						
2	Number of Masters qualifications obtained						
3	Number of other qualifications obtained						
4a	Number of undergraduate students receiving training						
4b	Number of training weeks provided to undergraduate students						
4c	Number of postgraduate students receiving training (not 1-3 above)						
4d	Number of training weeks for postgraduate students						
5	Number of people receiving other forms of long-term (>1yr) training not leading to formal qualification (e.g., not categories 1-4 above)						
6a	Number of people receiving other forms of short-term	52	Malagasy	Female (8),	Training in field botany 4 people for 3 months;	Malagasy	

	education/training (e.g., not categories 1-5 above)			Male (104)	Training in conservation horticulture 6 people for 3 months; training in best nursery practise 106 people		
6b	Number of training weeks not leading to formal qualification	226			Training in field botany 4 people x 12 weeks; Training in conservation horticulture 6 people x 12 weeks; training in best nursery practise 106 average 1 week		
7	Number of types of training materials produced for use by host country(s) (describe training materials)						

Research Measures		**Total**	**Nationality**	**Gender**	**Title**	**Language**	**Comments/ Weblink if available**
9	Number of species/habitat management plans (or action plans) produced for Governments, public authorities or other implementing agencies in the host country (ies)						Participatory process?

10	Number of formal documents produced to assist work related to species identification, classification and recording.	1	International but hosted by MBG, St Louis, USA.		TROPICOS database (Catalogue of the plants of Madagascar)	English	Enhanced with the integration of collection notes and images associated with 2077 specimens. This database is the most important aid for the identification of Malagasy plants (http://www.tropicos.org/Project/Madagascar)
11a	Number of papers published or accepted for publication in peer reviewed journals						
11b	Number of papers published or accepted for publication elsewhere						Location?
12a	Number of computer-based databases established (containing species/generic information) and handed over to host country						
12b	Number of computer-based databases enhanced (containing species/genetic information) and handed over to host country	1	TROPICOS (freely available on line throughout the World)		Collection information and photos associated with 2077 herbarium specimens		
13a	Number of species reference collections established and handed over to host country(s)						
13b	Number of species reference collections enhanced and handed over to host country(s)	1	Herbarium at PBZT, Madagascar		Total of 2077 Herbarium specimens enhancing the		

					herbarium at PBZT		

Dissemination Measures		Total	Nationality	Gender	Theme	Language	Comments
14a	Number of conferences/seminars/workshops organised to present/disseminate findings from Darwin project work						
14b	Number of conferences/seminars/ workshops attended at which findings from Darwin project work will be presented/ disseminated.	3			Need, approach and results of DI project.		1. 2017: Chris Birkinshaw presented preliminary results of DI project at the "Association pour l'Etude Taxonomique de la Flore d'Afrique Tropicale" Congress in Nairobi in 2. 2018: Chris Birkinshaw presented preliminary results of DI project during Seminary at Missouri Botanical

Dissemination Measures		Total	Nationality	Gender	Theme	Language	Comments
							Garden, St Louis. 3. 2019: Chris Birkinshaw will present final results of the DI Project at the World Congress of the Society for Ecological Restoration at Cape Town in September 2019

Physical Measures		Total	Comments
20	Estimated value (£s) of physical assets handed over to host country(s)	£25000	Includes camping and collecting equipment, installation of two plant nurseries, nursery equipment, rehabilitation of one building (used to house trainees during training), supplies and equipment for SNGF seedbank
21	Number of permanent educational, training, research facilities or organisation established	1	This concerns the establishment of the *ex-situ* plant conservation facility at Parc Ivoloina
22	Number of permanent field plots established		Please describe

Financial Measures	Total	Nationality	Gender	Theme	Language	Comments

23	Value of additional resources raised from other sources (e.g., in addition to Darwin funding) for project work	£95,435					Includes both funds accessed during project and post project (see Section 8.2)

Annex 4 Aichi Targets

	Aichi Target	Tick if applicable to your project
1	People are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.	✓
2	Biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems.	
3	Incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the Convention and other relevant international obligations, taking into account national socio economic conditions.	
4	Governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits.	
5	The rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.	
6	All fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.	
7	Areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.	
8	Pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity.	
9	Invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment.	
10	The multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning.	
11	At least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes.	
12	The extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.	✓
13	The genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.	✓

14	Ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.	
15	Ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.	
16	The Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization is in force and operational, consistent with national legislation.	
17	Each Party has developed, adopted as a policy instrument, and has commenced implementing an effective, participatory and updated national biodiversity strategy and action plan.	
18	The traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of indigenous and local communities, at all relevant levels.	
19	Knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss, are improved, widely shared and transferred, and applied.	✓
20	The mobilization of financial resources for effectively implementing the Strategic Plan for Biodiversity 2011-2020 from all sources, and in accordance with the consolidated and agreed process in the Strategy for Resource Mobilization should increase substantially from the current levels. This target will be subject to changes contingent to resource needs assessments to be developed and reported by Parties.	

Annex 5 Publications

Type * (e.g. journals, manual, CDs)	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. web link, contact address etc)

Data not yet published as waiting for 12-month germination and survival data for most recently collected seed samples from February and March 2019.

Annex 6 Darwin Contacts

Ref No	Project 23-004 ref 3339
Project Title	Ex-situ conservation of threatened plants from the Ivoloina-Ifontsy valleys, Madagascar
Project Leader Details	
Name	Dr Karen Freeman (Research Director, MFG)
Role within Darwin Project	Co-director
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Phone	
Fax/Skype	
Email	
Partner 1	
Name	Dr Chris Birkinshaw (Technical Advisor)
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Partner 2	
Name	Yvanni Rabenitany (Director)
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Partner 3	
Name	Stuart Cable (Head of Madagascar Program)
Organisation	Royal Botanic Gardens, Kew
Role within Darwin Project	Seed Banking
Address	
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Partner 4	
Name	Rapanarivo Solo Hery (Head of Flora Dept)
Organisation	Parc Botanique et Zoologique de Tsimbazaza
Role within Darwin Project	Facilitating research permit

Address	
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Email	