Final Evaluation Report

Your Details	
Full Name	Taruhim Miranda Cardoso Quadros
Project Title	Restoring the past, reconstructing the future: how genetic parameters can support forest restoration?
Application ID	26594-1
Grant Amount	£4977
Email Address	talumcq@hotmail.com
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1. Indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.

Objective	Not achieved	Partially achieved	Fully achieved	Comments
(i) what is the genetic constitution of some conserved fragments surrounding restoration areas?				
(ii) does the distance from these native areas influence the genetic parameters of passive restoration areas?				Instead of focusing on the original objective (ii), we decided to investigate functional connectivity between areas in a general level, to comprehend it in a landscape perspective: (ii) do restoration contributes to connectivity patterns of restored and native populations in a genetically perspective.
(iii) do active restoration, passive restoration and forest remnants differ from each other in its genetic pool and spatially structure?				Due to unexpected problems as described below, we reformulated this project original objective: (iii) do forests restored with different methodologies and forest remnants differ from each other in its genetic constitution?
(iv) does the seedling implanted for coverage in active restoration genetically differ from the native populations?				
(v)				We noticed that uncertainties in restoration topics may also be related to the geographic scale, such as local, regional and broader approaches. Thus, we added a new objective: (v) do restored populations contributed to the genetic aspects of an endangered native species in a local and regional perspective?

2. Please explain any unforeseen difficulties that arose during the project and how these were tackled.

The major unforeseen difficulty in this project was finding restored areas exclusively by passive methods. We visited 49 previously defined restored sites, that could potentially be studied (all in Southern Bahia). During this ground-check step, we found out that most passive restored sites were mainly covered by brachiaria and arbustive species. After speaking with our partners, we decided to investigate the characteristics of different actively restored areas, including one assisted natural regeneration area that we found. We strongly believe that in changing to this approach, we were able to trace a most feasible strategy to convert our results in practical ways once restoration stakeholders in our region mostly adopt active restoration with several methodologies. As a consequence, some objectives were adjusted, and are described in the table above and at item 12 (*Any other comments*).

Another difficulty found during this project execution was related to the method of fund transference. To tackle the necessity of an organisational bank account, we had to use our NGO partner account. Even though they were promptly helpful, the use of its account involved some major limitations. To properly respect the legislation regarding the NGO, we had to buy strictly from sellers that emitted tax invoices (in Brazil, called Nota Fiscal). To acquire a tax invoice, the seller had to register our NGO electronically. Nonetheless, in some situations, small business does not have the equipment to do so. For example, in most of the field activities, we were allocated in small communities/villages, and not all of the business emitted tax invoice. One time, we had problems with our car, and the only mechanical workshop nearby was a small one, that did not emit tax invoices, and we were not able to pay it with the project funding due to it. Fortunately, it was a minor problem, and the mechanic did it as a favour, for free. I suppose that the change to how grants are paid was made after careful consideration, but I suggest that all points of view should be taken into account, and, sometimes, it may create difficulties for the execution of the project.

3. Briefly describe the three most important outcomes of your project.

Fortunately, with the dedication of all the team members, we were able to discover some insightful results about restoration. Considering that only a short amount of time has passed after the conclusion of our analysis, I will describe the most important outputs and some mid-term results, indicating how they are impacting the stakeholders.

1. Restoration facilitated a functional state in the landscape - it contributed to the reestablishment of functional connection between forest patches in fragmented landscapes. We discovered it through the occurrence of gene flow between restored and native populations. This is a highly desirable outcome for the ecosystem.

2. Restored populations of the endangered species studied, *Dalbergia nigra*, represented a bank of the overall genetic diversity found in southern Bahia. We discovered that populations in different regions of southern Bahia had differences in

their genetic constitution. We believe that, naturally, the species population in Bahia would be genetically similar, as suggested by another study. We hypothesise that the difference found is a consequence of the detrimental anthropogenic actions in the Atlantic Forest, potentiated by the intense exploitation of *D. nigra* populations due to its wood value. In this scenario, restoration contributed to reducing this differentiation between populations from distinct regions, because it functioned as an exchange of genetic information between regions. For instance, we found that a population restored with seedlings that came from a highly conserved reserve in another state, Espírito Santo (approximately 500 km away), had a partial genetic constitution similar to populations of Bahia. Hence, restoration should aim not only in achieving a similar pattern as the ones found in native populations but mainly be designed as an opportunity to genetically rescue those disturbed native populations. In practical terms, this means two main points:

- Restored sites represent an extremely valuable *ex-situ* conservation strategy.
- Seed collection methodologies for restoration can involve seeds collected locally (nearby the site being restored), in the same region were restoration will take place, but also a mix of different regions, including several distinct populations.

For our patterns, the second point is really important. They signaled that it can be highly instructive information that can facilitate restoration. Sometimes, a limiting factor in implementing restoration is the number of seedlings available in a unique nursery. Thus, a major output is that a feasible strategy for restoration is its implantation with seedlings coming from different nurseries, including nurseries from different states (for conserved populations). Also, it means that communities collecting seeds and nurseries can exchange seeds and vegetal materials. We believe that, progressively, it may favour the creation of a seed production and supply chain. Through our workshops, we believe that we have not only encouraged communities to exchange knowledge, but we have strengthened the awareness of the importance they have for nature conservation.

3. The genetic pool found in restored populations of *D. nigra* have particularities related to each site and methodology adopted. The way in which restoration was carried out (quantity of seedlings, size of the area, number of matrices in the collection of seeds) influences the genetic characteristics of the population and can cause an increase in reproduction among related trees (inbreeding). In practical terms, it means that if there are restrictions on the availability of seedlings from the same species, we recommend the distribution of seedlings throughout the entire restoration area, without agglomeration, to avoid inbreeding. Most importantly, in all seed collection strategies, several trees and several populations must be mixed to ensure long-term genetically viable populations.

4. Briefly describe the involvement of local communities and how they have benefitted from the project.

Communities were involved in the project elaboration and in the field sampling activities, guiding us in the native areas and in the restored areas. Also, they have made valuable contributions to the comprehension of our results, through the

association of genetic data and information about the restored areas. They have been part of our feedback strategy, participating in meetings and workshops.

A first benefit was that during the field trips, we mapped new trees that they did not use as sources of seeds. Thus, we provided a database with location of trees (GPS points) that can potentially contribute to the seed collection strategy. Some have already used this information for last year's seed collection (2019).

The second benefit was achieved by the comprehension and dissemination of our findings, in which we reinforced their role in the broad perspective of nature conservation, and provided practical actions that may help in seed collection strategies, seedlings production, and restoration actions (as cited above). Now, they have scientific knowledge to reinforce they practical knowledge.

5. Are there any plans to continue this work?

Yes. During the execution of this project, we notice the potential to continue the work, due to the limited knowledge on the topic in our region, and the high interest of stakeholders involved. Thus, this project lead to the development of one big project involving three Atlantic Forest species used in restoration. The genetics restoration topic was adopted in my research group (Genética da Conservação UESC - https://gaiotto2.wixsite.com/geneticaconservacao) and in a lab I am a member (Laboratório de Ecologia aplicada à Conservação - https://www.appliedecologylab.org/), resulting in seven post-graduation students working on new restoration projects.

6. How do you plan to share the results of your work with others?

We are already acting on the dissemination of our work. In terms of the scientific community, we are concluding the elaboration of a paper to be submitted this month to the *Restoration Ecology Journal*. I have already participated in a seminar to share our findings, and there are at least two more congresses this year that we will share this project results.

In terms of the restoration stakeholders, we have already conducted meetings and workshops to disseminate our findings and to discuss its implications. During the last couple of months, we did it with our partners Suçuarana Florestal, Veracel, Symbiosis, Instituto Floresta Viva and Suzano Celulose (former Fibria) and all communities involved with them. Now, the next phase is to share it with Programa Arboretum, and send flyers created with practical implications to be adopted. Educational videos will also be produced and posted in our social networks (that I have created in the past year) and sent to our partners.

Website- https://gaiotto2.wixsite.com/geneticaconservacao
Facebook - https://www.facebook.com/geneticaconservacaoUESC/

7. Timescale: Over what period was the grant used? How does this compare to the anticipated or actual length of the project?

The grant was mainly used during the field activities, in the period of months 1 to 6, to cover our travel expenses. Eventually, we had to re-collect samples, returning to the field in month 8. The grant was also used to buy the tree reagents in the month 5-6.

8. Budget: Provide a breakdown of budgeted versus actual expenditure and the reasons for any differences. All figures should be in £ sterling, indicating the local exchange rate used. It is important that you retain the management accounts and all paid invoices relating to the project for at least 2 years as these may be required for inspection at our discretion.

Item	Budgeted Amount	Actual Amount	Difference	Comments
Fuel	1917	1812	-105	
Toll road	40		-40	The roads we traveled did not have toll roads
Car rent	732	732		As planned, we needed to rent a car to field activities for 36 days
Driver	286	529	+243	Driver expenses were £20.35 per day, we needed for 26 days (in the other 10 days a member of the team was available to drive)
Food	366	512	+146	Food costs included alimentation for the team in field activities (including the community worker that guided us in the areas)
Equipment	441	156	-285	My work group received a GPS as donation thus I did not need to buy one
Subsistence payment for local team	259	476	-217	We had estimated a value of 9.96/ day, but it was 18.30/day. We required field assistance for 26 days, as proposed in the original project.
Lodging	692	512	+180	Lodging per day was cheaper than planned, totalizing 512.20 (14.23/day)
Lab reagents	244	244		-
TOTAL	**4997**	**4973**	**-24**	Local exchange rate: £1 = R$4.92

9. Looking ahead, what do you feel are the important next steps?

The most important next step for me is keeping track of our suggestions - we need to monitor areas restored according to our practical guidelines, implanted by our partners. By doing so, we can comprehend if our outcomes will conduct to what we desired, genetically viable restored populations. As we already have the restoration genetics topic being investigated by other colleges, we believe this will be possible for the following years.

10. Did you use The Rufford Foundation logo in any materials produced in relation to this project? Did the Foundation receive any publicity during the course of your work?

Yes. In two seminars, one in a national park (Descobrimento National Park in Prado, Bahia), other inside my university. I also used The Rufford Foundation logo in my project presentation to acquire my MSc title, and in the feedbacks/workshops with our stakeholder partners.

11. Please provide a full list of all the members of your team and briefly what was their role in the project.

Fernanda Amato Gaiotto – provided assistance in project elaboration, field activities, lab analysis and all steeps of this project.

Daniela Custódio Talora – provided support to field activities helping in the most adequate sampling strategy. Helped with interpretation of our findings in an ecological perspective.

Taise Conceição de Almeida – she was a very helpful college that assisted in field sampling, making possible to collect a total of 856 plants in 23 areas. She also collaborated in the genetic procedures in lab.

Maíra Caetano de Andrade – assisted in some field trips and data analysis, elaborated the maps for this project.

Ilana Araújo - assisted in some field trips.

Reinaldo J. S. Filho – he was the driver in our field trips.

Adson F. dos Santos, Mário Mantovani, Márcio do Amparo, Lourival Brasiliano do Espirito Santo – local community members with knowledge of the regions that assisted in our field activities.

Tathiane Santi Sarcinelli, Danilo Sette, Felipe Garbelini Marques, Vírgínia de Camargos and Priscilla Gomes – partners that were essential to the recognition of restored areas to sample, and also assisted in the ground-check steep, in the pilot project and in some field collections.

Marcos Penna – he was our financial management that helped me with the project budget and expenditure.

12. Any other comments?

In the granted proposal, the specific objectives were:

> (i) What is the genetic constitution of some conserved fragments surrounding passive restoration areas?
>
> (ii) Does the distance from these native areas influence the genetic parameters of passive restoration areas?
>
> (iii) Do active restoration, passive restoration and forest remnants differ from each other in its genetic pool and spatially structure?
>
> (iv) Does the seedling implanted for coverage in active restoration genetically differ from the native populations?

Due to difficult to find passive restored areas in southern Bahia, we modified the objectives:

> (i) What is the genetic constitution of some conserved fragments surrounding restoration areas?
>
> (ii) Do restoration contributes to connectivity patterns of restored and native populations in a genetically perspective?
>
> (iii) Do forests restored with different methodologies and forest remnants differ from each other in its genetic constitution?
>
> (iv) Does the seedling implanted for coverage in active restoration genetically differ from the native populations?
>
> (v) Do restored populations contributed to the genetic aspects of an endangered native species in a local and regional perspective?

I would like to thank The Rufford Foundation for the opportunity to execute this project. We are glad we could contribute to advances in the forest restoration in Brazil. All of our partners and also other restoration stakeholders were very interested in our outcomes and shared our excitement to convert scientific knowledge to practical actions that can improve restoration achievements over time.


Photograph 1. The studied species – *Dalbergia nigra*, also known as rosewood, an endangered native tree of the Atlantic Forest in Brazil. In the photo, a tree planted in an active restored area. © Taruhim M. C. Quadros. **Photograph 2.** A remaining rosewood tree in a natural forest located in southern Bahia. © Taruhim M C Quadros.


Photograph 3. A restoration area with rosewood trees and other Atlantic Forest species. © Taruhim M C Quadros. **Photograph 4.** Natural regeneration inside a restoration area located in southern Bahia, in an Atlantic Forest domain. © Taruhim M C Quadros.


Photograph 5. Taruhim in one of the sampling campaigns in southern Bahia - BR, alongside a rosewood tree sampled. © Taise Almeida. **Photograph 6.** Part of the

project team in one of the field trips. From the left to the right, Ilana Araújo, Maíra Caetano de Andrade and Taruhim M. C. Quadros. © Taise C. Almeida.

Photograph 7. Taruhim in one of the sampling campaigns in southern Bahia - BR, alongside a rosewood tree sampled. © Taise C. Almeida.