Final Evaluation Report

Your Details	
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Project Title	Back to the bases: assessing forest dynamics to provide conservation guidelines for the Brazilian Atlantic Forest
Application ID	27666-1
Grant Amount	£4,997
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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
Accurately estimate the above-ground biomass of tree communities in subtropical forests to compare with other forest ecosystems and evaluate their contribution to the regional and global carbon cycle				Sub-tropical forests stock a great amount of above-ground biomass (245 Mg ha^{-1} in average), which is similar to other tropical forests in Brazil. It reinforces the need to protect these forests, as they have a great importance for the global carbon cycle. This manuscript is under review at Forest Ecology and Management.
Determine the annual net biomass change in forests of distinct sites in the subtropical portion of the Brazilian Atlantic Forest as a result of the growth, recruitment, and mortality of trees to evaluate the carbon sink capacity of these forests				The fieldwork for re-measuring trees in the nine permanent plots was finished. Our team measured at least 2,575 trees (2,013 individuals survived from the first to the second census, 275 were recruited and 287 died). The analyses for evaluating the biomass dynamics just started and will be integrated with another manuscript.
Understand the role of plant functional traits, soil, and climatic variables in drive forest biomass dynamics, and the influence of the diversity in these relationships				We evaluated the relationship among these variables and biomass stocks. Climate (temperature range) and the proportion of large-sized trees have negative and positive effects in predicting above-ground biomass in these Brazilian Atlantic Forests. On the other hand, functional traits and soil variables did not affect the biomass stocks in this region. For completely achieving this aim, we will still evaluate the relationships among these variables and biomass dynamics in a next manuscript, as previously mentioned.
Identify which functional traits can predict the species performance				The fieldwork for re-measuring trees in the nine permanent plots was finished, as said above. The

over time (growth, recruitment and mortality) in forests under distinct soil and climate conditions, thus contributing to the advancement of functional ecology based on field data that include the interplay of traits, demography and species interactions in local communities				functional trait information (leaf and wood traits) was also collected and organised. The analyses for evaluating the prediction power of functional traits on species performance will start soon.
Improve the knowledge and the databases of plant functional traits of subtropical tree species by locally collecting leaf, seed, and wood traits information				We integrated the information of functional traits collected for tree species in our sampling areas in a global database for trait information (TRY Plant Trait Database, www.try-db.org). Reference: Kattge et al. 2020, doi: 10.1111/gcb.14904 The trait information can be assessed anytime at TRY under formal request.
Integrate the sampled data in a larger network (ForestPlots database), supporting information for regional and global studies on forest dynamics and biomass changes				All data gathered from permanent plot sampling is available for use under formal request via www.forestplots.net/
Reveal the importance of such forest areas for the maintenance of biomass stocks and ecological services, providing arguments and efforts for conservation purposes face of current and future climatic changes				We evaluated the importance of the sub-tropical Brazilian Atlantic Forest in terms of biomass storage (manuscript under review at Forest Ecology and Management). Our results support the great capacity of these forests to stock biomass and reinforce the strong influence of the climate (temperature) and forest structure (large-sized trees) for maintaining carbon stocks. Old-growth remnants retain higher proportions of large sized trees, which reinforces the needs of conservation of these areas for providing ecosystem services, and to allow the maintenance of the

				global carbon cycle. Also, we found a negative effect of temperature annual range, which sheds light on the potential negative effects of ongoing global temperature increase on above-ground biomass stocks in South American subtropical forests.

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

During the development of the project, we had some issues related to climatic conditions, which led to a delay in data collection. These issues were mainly related to excessive precipitation rates, which did not allow the field survey as we could not proceed with the tree identification and tagging. It led us to reschedule our activities.

Also, the COVID-19 pandemic stopped our fieldtrips, to avoid any possibility of contamination. We finished the samples once we had more security to accomplish the activities, taking in account all the WHO recommendations.

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

1) Above-ground biomass estimation: We provided the first picture of the above-ground biomass stocks in the subtropical Brazilian Atlantic Forest. This is a great achievement, as it provides information about the great potential of these forests in stocking biomass and carbon. Also, we described the main biotic and abiotic drivers associated with biomass stocks, which are temperature and proportion of large sized trees. From the conservation perspective, it reinforces the need to protect forest remnants, which increases the possibility of trees achieving large sizes, and consequently, stocking more biomass and carbon in the future.

2) Standardising data collection: During the development of the project, we had the opportunity of applying standardised methods of survey and maintenance of long-term plots, by using tree tags and by marking the point of measurement of each tree. It is extremely important, as it provides an accurate circumference measure of the surviving trees through time.

3) Forest dynamics: By remeasuring all the trees in the long-term permanent plots maintained by our team, we have collected excellent data on tree growth, mortality, and recruitment. This information will be used to evaluate the sub-tropical Brazilian Atlantic Forest dynamics, in terms of biomass and stem density changes. Also, these data have been stored at ForestPlots database, which allows the opportunity of many other researchers to assess and use these data.

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

The local community was indirectly involved in our project. Our project had the aim of characterising the sub-tropical Brazilian Atlantic Forest in terms of biomass stocks and forest dynamics, and the potential predictive power of functional traits and soil in the forest structure and dynamics. The benefits of this work for local communities are to acknowledge the importance of these forests for the maintenance of global carbon cycle and ecosystem services. Also, some undergraduate students were directly involved with the project, being connected with the methodologies and theories behind the study. This has certainly improved their academic knowledge and nature services view.

5. Are there any plans to continue this work?

Yes, personally, I aim to use the data collected with this project in at least two new manuscripts, which will comprise my PhD thesis. Also, the long-term permanent plots will be maintained by looking at distinct funding sources through time. Our team aim to conduct census at 5-year intervals to monitor long-term changes in the sub-tropical Brazilian Atlantic Forest structure. Moreover, other PhD students in our lab are now investigating other parameters of forest dynamics, such as effects of species competition on tree growth.

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

We consider extremely it important to share the results of our work with the scientific community, protected area managers and the general population. For instance, we have already submitted a manuscript with some results gathered from the project; we included all tree community information along the surveys into a global network (www.forestplots.net/); we plan to develop a workshop with the managers of the protected areas where the permanent plots are located, in order to present the main results obtained. In the meantime, we created pages on Instagram (@leveg.ufrgs) and Twitter (@Leveg_UFRGS), to improve the scientific communication with people, by promoting posts presenting the results and future implications of our works. Also, we have published some articles in local journals (https://www.ufrgs.br/jornal/as-florestas-e-as-mudancas-climaticas/), and we were interviewed by a local news for sharing relevant results of our works for people.

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

We used grant money to cover the expenses of the field expeditions for 18 months, from April 2019 to October 2020. We conducted six expeditions for data collection in nine long-term permanent plots. Our previous expectation was to finish the project in 12 months; however, due to climatic issues and COVID-19 pandemics previously mentioned, we had to extend the expected schedule.

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
Field trip food	2633	2908	+275	The team that conducted the fieldwork had more people than we planned.
Fuel for field expeditions	1224	1092	-132	
Soil analysis	588	353	-235	We analysed soil samples for a good price, and used the money saved here to pay material for tree tagging.
Material for tree tagging	80	250	+170	We used more material for tree tagging than we planned.
Leaf nutrient analysis	392	53	-339	We analysed leaf samples for a good price, and used the money saved here to pay fieldtrip food.
Fieldwork equipment	80	68	-12	
Total:	4997	4724	-273	If RSG allows, we will use this amount for conducting field expeditions to collect more leaf and wood samples for measuring functional traits.

The local rate exchange used: £ 1, 00 = R$ 4.90

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

As a result of this project, we could estimate accurately the above-ground biomass stocks and, ultimately, the forest carbon stocks in the sub-tropical Brazilian Atlantic Forest. Following the global trend to comprehend the potential in carbon storage both above- and below-ground, especially in the endangered Brazilian Atlantic Forest, we aim to analyse the soil carbon stocks in the same permanent plots evaluated with this project.

As we know, plants often have different allocation strategies (i.e., above and below-ground), and understanding the relationships on the carbon stocks in these both compartments will provide important information on the importance of the sub-tropical Brazilian Atlantic Forest for the global carbon cycling. Recent reports have shown that the greatest predictor of biomass stocks found in our study, the large sized trees, have been suffering with the consequences of recent climatic changes, leading to the greatest mortality of these trees in forests worldwide (see Bennett *et*

al. 2015, DOI: 10.1038/NPLANTS.2015.139). In this sense, to evaluate the potential of the soils in stocking carbon in the sub-tropical Brazilian Atlantic Forest is crucial to understand their power facing the current and future climatic changes (Doetterl et al. 2015, DOI: 10.1371/journal.pone.0143209).

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, the logo was used in formal presentations with a great publicity at least twice. The first time was at a seminar for Masters and PhD students in ecology. The second time was in a public presentation for a qualified team of experts in community and forest ecology. Also, every field assistant our field sampling trips heard about Rufford verbally and informally, as we are proud of having received RSG support and extremely thankful for the grant. The Rufford Foundation will be acknowledged in every scientific publication derived from this project.

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

Kauane Maiara Bordin was the main researcher. She was the project developer and leader, field leader, data collector, data analyst and manuscripts leader.

Adriane Esquivel-Muelbert provided a great intellectual content for the project development, data analysis and manuscript writing.

Sandra Cristina Müller provided a great intellectual content for the project development, data analysis and manuscript writing.

Rodrigo Scarton Bergamin contributed as field assistant, with a great knowledge in tree species identification and forest ecology.

Joice Klipel contributed as field assistant, with a great knowledge in trait collection and measurement.

Rayana Caroline Picolotto contributed as field assistant, with a great knowledge in tree measurement and soil collection.

Davi Morales da Cunha contributed as field assistant.

Caroline Moreira Basilio contributed as field assistant.

Maico Fiedler contributed as field assistant.

Pedro Augusto Thomas contributed as field assistant.

Marcelo Araujo Frangipani contributed as field assistant.

Figure 1: Forest remnant located at Maquiné, Rio Grande do Sul, Brazil. Note the pink marks and the tree tags, which represents the point of measure and individual tree identification. Photo: Kauane Maiara Bordin ©

Figure 2: Forest remnant located at Cambará do Sul, Rio Grande do Sul, Brazil. Note the presence of the gymnosperm *Araucaria angustifolia*, the Brazilian Pine, which characterises the Araucaria Forest in southern Brazil. Photo: Kauane Maiara Bordin ©

Figure 3: Forest remnant located at Maquiné, Rio Grande do Sul, Brazil. Note the presence of the palm *Euterpe edulis*, commonly known as “Palmito-juçara”, which is an indicator species of the Atlantic Forest in southern Brazil. Photo: Kauane Maiara Bordin ©