

Final Project Evaluation Report

We ask all grant recipients to complete a project evaluation that helps us to gauge the success of your project. This must be sent in **MS Word and not PDF format**. We understand that projects often do not follow the predicted course but knowledge of your experiences is valuable to us and others who may be undertaking similar work – remember that negative experiences are just as valuable as positive ones if they help others to learn from them.

Complete the form in English and be as concise as you can. Note that the information may be edited before posting on our website.

Please email this report to jane@rufford.org.

Your Details	
Full Name	Alci Albiero Junior
Project Title	How the forest fragmentation of the Brazilian Central Amazon is affecting the growth dynamics, carbon accumulation and tree mortality during their life cycle?
Application ID	18762-1
Grant Amount	Março 2016 - Agosto 2017
Email Address	£4940
Date of this Report	albierojunior@usp.br

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
Sampling of four species				Due to the extensive work of marking growth rings and chronologies construction for tropical tree species. It was decided to use in the study three tree species with dendrochronological potential and with great representativeness in the study area.
Evaluation of trees in different successional groups				It was decided not to use the successional classification of pioneer and non-pioneer trees due to the lack of pioneer individuals in the interior of the forest, probably making unfeasible the sample sufficiency. Thus, in addition to the dendrochronological potential, canopy and sub-canopy categories were used as the basis for species definition. Canopy trees sampled at work are: <i>Scleronema micranthum</i> and <i>Hevea guianensis</i> , and sub-canopy as <i>Theobroma sylvestre</i> .
Growth evaluation				Through a dendrochronological perspective, it was verified that forest fragmentation and edge effects are altering the growth dynamics of terra firme trees in the central Brazilian Amazon. Increasing the growth of trees exposed to edge effects mainly in the first 5 years after fragmentation.
Mortality evaluation				Due to the accelerated process of decomposition to which trees are exposed in central Brazilian Amazon, dead individuals in good condition for the removal of samples of wood discs were not

				found in the field.
Carbon stock				Preliminary analyses show that the higher growth of trees exposed to edge effects, especially in the first 5 years of fragmentation, reflects higher biomass stored in the wood during the period. However, future analyses with X-ray densitometry will be developed to verify if the increase of biomass is observed throughout the life of the trees.
Climate change				Relations with precipitation proved the strong influence of rainfall on the dynamics of tree growth. Revealing that water resource may be previously available for interior trees.

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

Although the annual formation of growth rings in tropical trees is corollary, dendrochronological studies in Amazonian Terra Firme Forests are challenging. One of the biggest difficulty is the presence of false rings, which in many cases make it difficult to cross-dating. Thus, it is believed that research with growth rings in these environments should be developed with great responsibility. Confirming the annual dating of growth rings by different methods, as in this project through cross-dating and climatic relationships.

The accelerated process of decomposition that was observed in the trees used as object of studies (*Scleronema micranthum*; *Hevea guianensis*; *Theobroma sylvestre*) made it impossible to collect woody material for dating by counting growth rings. However, wood samples were collected for future isotopic analyses ¹⁴C.

Due to the difficulty of sampling pioneer trees in interior forest, we chose to compare the growth response to fragmentation and edge effects in trees of canopy and sub-canopy. The comparison by stratum may provide new perspectives of the response of trees of different functional groups to the effects of fragmentation of central Amazon, fomenting greater generalizations on the growth responses.

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

During the field expeditions 175 trees were sampled (57 *Hevea guianensis*, 68 *Scleronema micranthum* and 50 *Theobroma sylvestre*). Of these, 101 in forest edge (37 *H. guianensis*, 44 *S. micranthum*, 20 *T. sylvestre*) and 74 in forest interior (20 *H. guianensis*, 24 *S. micranthum* and 30 *T. sylvestre*).

Up to now, growth ring chronologies have been constructed for 21 *S. micranthum* trees in edge site and 15 *S. micranthum* trees in interior site. High correlation values between series confirm the annual nature of growth rings. Proving by cross-dating that the growth of *S. micranthum* trees is periodic and influenced by the climatic seasonality. Inducing the trees to present common pattern in the annual variation of the width of the growth rings.

Through the counting of the rings we verified that trees exposed to edge effects had a mean age of 74 years (Max.115/Min.38) and for trees not exposed to the edge effects the average age was 88 years (Máx.138/Min.50).

The results confirm the potential of the growth rings as bio-indicators of the growth dynamics changes due to fragmentation effects. And they prove that the fragmentation of the area and creation of the edge potentiated the differences of basal area increment (BAI) observed, promoting an increase of growth in trees exposed to edge effects.

Increased trees growth in edge may induce these individuals to anticipate senescent processes. Affecting the potentiality of its ecosystem services such as carbon sequestration.

Growth rings proved the temporality of edge effects, identifying a return to the more homogeneous BAI pattern five years after fragmentation and thus confirming the dynamic nature of forest edges.

Positive and significant relationships with rainfall in October and November on edge trees confirm the strong influence of the increase of rains after the period considered dry in the formation of growth rings and wood production. Relationship previously observed for interior trees, indicating that the water resource may be available in advance for the trees in that environment.

Growth ring studies are expected to promote new insights and perspectives on the influence of fragmentation effects on the life dynamics of Terra Firme trees in the Brazilian central Amazon. Highlighting this approach in forest fragmentation evaluation using the growth rings of tropical forests.

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

5. Are there any plans to continue this work?

Yes. The next steps of the project will be:

- i) Dendrochronological analysis for the species *Hevea guianensis* and *Theobroma sylvestre*.
- ii) Performing X-ray densitometry analyses.
- iii) Realization ¹⁴C isotope analysis for dead trees.

iv) Inclusion of new species.

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

Papers, conferences, congresses and lectures.

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

The RSG was used during the year 2016. Mainly from April/2016 to September/2016. Period during which the field expeditions and the collection of radial samples of wood were carried out.

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
Air tickets	632	1254	+622	Activities related to the PhD at the University of São Paulo had to be carried out during the field activities, increasing the number of trips São Paulo-Manaus-São Paulo
Recognition expedition	333	0	-333	Resource obtained through the Biological Dynamics of Forest Fragments Project
Assistant field	1148	500	-648	Part of resource obtained through the Biological Dynamics of Forest Fragments Project
Ethnobotanical assistant	1356	825	-531	Part of resource obtained through the Biological Dynamics of Forest Fragments Project
Camp	156	312	+156	Part of resource obtained through the Biological Dynamics of Forest Fragments Project
Feeding (camp)	751	1350	+599	Due to the increase in field stay, the cost of feeding was higher
Transport to field	78	88	+10	More trips to field was realized, increasing transport cost
Driver to field	312	300	-12	Part of resource obtained through

				the Biological Dynamics of Forest Fragments Project
Field material	174	641	+467	Field materials that would be made available by Wood Anatomy & Tree-Ring Lab / ESA were not in good working order. Thus, new equipment (e.g. GPS, photographer camera) were purchased with RSG
Increment borer	0	0	0	Resource obtained through Wood Anatomy & Tree-Ring Lab/ESALQ/USP
X ray analysis	0	0	0	Resource obtained through Wood Anatomy & Tree-Ring Lab/ESALQ/USP
Conference and Workshop	0	0	0	Resource obtained through Wood Anatomy & Tree-Ring Lab/ESALQ/USP
TOTAL	4940	5270	330	

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

The next steps will be the construction of chronologies for the other species sampled and analyses of X-ray densitometry. These analyses will provide accurate quantification of the biomass stored in each growth ring. Demonstrating possible divergences in carbon stock in canopy and sub-canopy trees exposed to fragmentation effects.

The observation of increased basal area increment in trees exposed to fragmentation and the potential accelerating effect of senescence may indicate the strong transformation to which these trees are exposed in altered environments. Thus, the continuation of the study may confirm this hypothesis, revealing the real state of conservation and resilience found in trees located at the edge of forest fragments.

We believe that growth ring studies may provide new perspectives on tree behaviour over a lifetime when exposed to fragmentation effects. Providing a greater understanding of the permanent transformations that occur in forest populations in functions of perturbation factors. Providing valuable contributions in forest management and restoration practices through information on growth dynamics and biomass accumulation. Generating knowledge for environmental conservation programs and public policies.

Thus, we encourage the inclusion of new species in dendrochronological studies in edge areas of Terra Firme in the Amazon by the great bio indicator potential of their growth rings.

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. We use the logo of the RSGF in the poster "Growth rings: temporal bio indicators of forest fragmentation in the Brazilian Central Amazon" presented at the 68th National Congress of Botany held in the city of Rio de Janeiro/Brazil, during 20-25 August 2017. However the logo will be announced in all presentations that involve the project, highlighting the importance of the support for conducting the research.

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

12. Any other comments?

I am very grateful to RSG for believing in the potential of the project through the financial support provided. The resources obtained from the grant were essential for the development of the research and prove the potential of the growth rings as temporal bio indicators of forest fragmentation in tropical forests.