The Rufford Foundation
Final Report

Congratulations on the completion of your project that was supported by The Rufford Foundation.

We ask all grant recipients to complete a Final Report Form that helps us to gauge the success of our grant giving. The Final Report must be sent in **word format** and not PDF format or any other 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. Please be as honest as you can in answering the questions – remember that negative experiences are just as valuable as positive ones if they help others to learn from them.

Please complete the form in English and be as clear and concise as you can. Please note that the information may be edited for clarity. We will ask for further information if required. If you have any other materials produced by the project, particularly a few relevant photographs, please send these to us separately.

Please submit your final report to jane@rufford.org.

Thank you for your help.

Josh Cole, Grants Director

Grant Recipient Details	
Your name	Florencia Tiribelli
Project title	The importance of fuel structure and post-fire age on the flammability of Patagonian ecosystems: an approach for wildfire prevention and wildlife conservation
RSG reference	18549-1
Reporting period	2016-2017
Amount of grant	£5000
-Your email address	flopitiribelii@gmail.com
Date of this report	23/01/2017

1. Please 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
Measure vegetation structure in *N. dombeyi* forests and *N. antarctica* shrublands				We were able to measure fine fuel proportion and density, vegetation maximum height and the difference among vegetation layers (vertical continuity) in 36 post-fire stands.
Relate vegetation structure with time since fire				We detected the post-fire age at which *N. dombeyi* and *N. antarctica* reached maximum connectivity and maximum amount of fine fuels.
Detecting the most important species contributing to fine fuels				We determined which species contribute the most to dry and alive fuel.
Detecting fire susceptible areas within the studied national parks				We analysed the field data and we determined which vegetation type was most flammable employing flammability estimators such as: fine fuel proportion and density (for both dead and alive), vegetation vertical continuity and vegetation maximum height. Furthermore, we established the post-fire ages corresponding to maximum and minimum flammability for each vegetation type. This allowed us to identify areas susceptible to burning according to their respective post-fire age and vegetation type. As our study didn't cover the entire national park's surface we are extrapolating the data collected in the field with a

				time since fire map (tsf-map). This map was built with wildfire polygons provided by the National Parks Administration. With this map, we will also fit fire interval distributions which will allow us to tell how the hazard of burning changes along time since fire. Ultimately, this will let us assess whether the flammability patterns seen in the field correspond with the site's previous fire history.
Develop fuel models for *N. dombeyi* forests and *N. antarctica* shrublands in Patagonia.				We were able to detect five possible fuel models for these vegetation types and we have the data to actually develop them. However, the National Fire Management Plan is now trying to develop a national sampling protocol for fuel models for the whole country. Thus, we will try to collaborate with them in this task rather than developing fuel models with a different sampling protocol.
Write a report for the national parks				We wrote a report with preliminary results and had meetings with park rangers and fire fighters to discuss them. But we have not yet written a report with the final results and remarks. We are currently working in the complete final report.
Write a manuscript				We are currently working in a manuscript.

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

In Patagonia, accessibility to the sampling sites is one of the main issues when performing scientific research involving field sampling. We were supposed to sample 20 forests and 20 shrublands sites but we were only able to reach 18 of each vegetation type. Although we expected to find more accessible sites that burned different time ago, after developing an exhaustive search (both in the field and

trough fire records), we realise that there were less than expected, but sampled all the accessible ones.

During 2016 Argentina suffered a big devaluation of its currency. Moreover, importing material from abroad has been quite difficult for many years now and as a result we are forced to buy everything in the country. Thus, the expenses originally proposed in our budget had to be increased significantly. This budget overrun meant that acquiring some of the items we had initially planned was no longer possible (for example increment borers). Fortunately, our group had some old borers and, although slower, we were able to successfully sample the trees as we had planned.

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

1. The main outcome of our project is that communities dominated by post-fire re-sprouter shrubs have more fine fuels than vegetation dominated by colonisers (species that cannot resprout and do not have a post-fire persistent seed bank) and that these fine fuels are in a more compact arrangement. This is very important because these are the two main post-fire regeneration strategies that dominate Andean Patagonian landscapes. In this fashion, young forests (less than 40 years old) share a very similar vegetation structure with shrublands because they are dominated by understory resprouting species and trees are embedded within them. They have a high vertical and horizontal connectivity and a higher percentage of fine fuels. Older forests in turn, have less fine fuels and these are less dense due to the closed canopy structure that also leads to lower temperatures and a more humid environment. This information allows us to predict how flammable will the vegetation be at a given time in the future and hopefully help to prevent future fires. Moreover, understanding that forests lead to a less flammable community allows us to think that restoring burned sites with forest species will likely lead to a less flammable environment.

2. The second important outcome is in line with the first one. We were able to recommend management practices. For example, in a coloniser community, a fire suppression strategy may lead to a less flammable structure (reduced vertical continuity as the community ages) that may act as a natural fire break. Differently, in communities dominated by resprouters, fine fuel reduction by removing resprouting shoots and thus leaving fewer shoots per plant can be a very good management strategy to reduce the quantity of fine fuels especially near urban areas or roads. This will also improve accessibility for firefighting.

3. The third important outcome is that *Chusquea coleou* (bamboo) is the main contributor to the quantity of dry fuels in the landscape, especially after flowering

because it dies, leaving a high amount of fine fuels available. Although fire fighters and researchers could already tell that this could be so because of field observations, this is the first time that someone actually quantifies this pattern and determines its importance in the field. Accordingly, we can now confidently state that communities lacking this species have less dry fuels than those which do, and consequently these areas are very susceptible to burning. In addition, the old forest that happen to have this species in their understory will have their flammability drastically increased immediately following the flowering of this bamboo (this occurs every ~60 years), as the heat released by the potential burning of this species can burn the canopy of these forests where the main amount of fine fuels is located.

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

Due to the remoteness and isolation of many of the study sites and due to the fact that our entire study area was located within national parks we had little contact with local communities actually living next to the forests and shrublands sampled. In those few opportunities in which we met members of the local community, we discussed the nature of fire, its causes and main advantages or disadvantages. They gave us important insights and key information regarding the exact date of the last fire, how it had started and what type of vegetation was dominant back then.

During most of our sampling trips we had the opportunity to work very tightly with park rangers and other members of the conservation and fire prevention departments of the National Park Service. In many, if not in all the trips, park rangers either tagged along or helped us reach the exact spot that we were looking for or were of fundamental help in the logistics process behind it. By virtue of this, we were able to show them our sampling protocol. They, in turn, provided us with a large amount of suggestions, improvements and local knowledge. The very good relationship that we developed with park rangers throughout this process makes us very hopeful towards keep working together in the near future.

I also had the opportunity to participate at the "fire day" in a local school, where the children interviewed me about my work and my results. This provided me a great opportunity to generate some debate and build awareness regarding our forests and shrublands. This event encouraged us to visit other schools and we are hoping to do so next year when the academic calendar re-starts.

5. Are there any plans to continue this work?

We are planning to continue with this work. First of all we will finish the final report for the national parks and the manuscript for the scientific community. We will also

continue working with the National Parks fitting the time since fire interval distributions.

Lightning is now a major concern among the firefighting community in Patagonia since climate change is expected to drive an increase in the number of thunderstorms reaching Patagonia. In the past 10-20 years, previously extremely rare lightning-induced wildfires have started to become common during the summer. As the national parks have a lightning database our idea is to develop a lightning risk map to overlap with the vegetation data and the time since fire maps we have developed with this project. With this approach we expect to be one step closer to a realistic fire risk map.

Finally, we would like to repeat this research in other vegetation types also present in our study areas, like *Austrocedrus chilensis* forests, and perhaps also include other measurements useful for the National Fire Management Plan (e.g. bulk density).

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

During the last year we have communicated our results to park rangers, firefighters and national park staff in meetings and through a preliminary report presented a couple of months ago. We have shared much of our findings to the scientific community in presentations at conferences or workshops. All these preliminary results will be part of a scientific paper we are currently working on which will be published in a peer-reviewed journal.

Also, I had the pleasure to be interviewed in a local radio programme regarding our work and I was able to share some of our results to the local community. We have also been asked to participate of a national TV programme ("Científicos todo terreno") about our work and we are looking forward to this opportunity to make science more popular and accessible to everyone. Finally, I will present most of these results in my PhD dissertation which would be in 2.5 years.

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

The RSG was used from January 2016 to January 2017. From January to May 2016 we performed the field sampling. We had initially expected to finish sampling by early April but as we had to arrange many field campaigns with park rangers and summer is a very busy time for them, our schedule had to be modified. From June to October we analysed data and discussed the results among us and with firefighters and national park staff. These meetings generated new ideas that were very enriching. During this period we also wrote a report with preliminary results to the National Park

Service. Between September and November 2016 we presented our results in scientific meetings ("Reunión Binacional de Ecologia" and "Congreso Latinoamericano IUFRO de Ecología del Paisaje"). In December 2016 we started to work on a manuscript to be published in a peer-reviewed journal. This task will continue the next couple of months along with the final report to the National Park Service.

8. Budget: Please 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.

Item	Budgeted Amount	Actual Amount	Difference	Comments
Haglöf Vertex IVHypsometer	1000	1273	273	
Garmin GPSMAP 64s	400	399	-1	
4 Metric Tapes (50m)	100	98	-2	
4 Metric Fabric Diameter Tapes	150	192	42	
Gasoline for vehicles	800	988	188	We travelled long distances to the study sites and we also payed gasoline for the national parks boats when we needed to cross a lake (17 sites).
Vehicle Maintenance	550	700	150	In Patagonia roads are mostly gravel and our track is quite old.
Other expenses (e.g., meals during field work, library items, batteries, first aid kits, sandpaper for the cores)	1000	1350	350	
3 Haglöf 24" Complete Increment Borer, 3-Thread, .200"	1000	0	-1000	We were not able to buy them.
Total	5000	500	-11	1£ = 20 argentine pesos (January 2016)

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

An important next step is to start controlled fires in forests and shrublands of different post-fire age in order to make the link between vegetation structure and

flammability. This is a difficult task, not only because qualified staff is needed but also because of the permits involved and that social acceptance is needed. In Patagonia people are scared of fire because it poses a major threat to the regional economy and to public and private property. Anyhow, we believe that without burning in a controlled fashion it will be difficult to deepen our understanding of how vegetation modifies fire behavior.

Another important step is to study seed dispersal distances of our major coloniser species (species that can only regenerate after fire from remnant patches) in order to predict how vegetation structure changes after a fire, depending on the distance to remnant seeder trees and the probability of seedling establishment. These colonizer species are the dominant trees in our monospecific forests. If seeds of the colonizers species don't reach a given site or do not establish, the site won't turn into a forest and the vegetation structure will radically change into a more flammable type, because it would be dominated by re-sprouting shrubs. In consequence, we are starting a new project to study dispersal distances, seedling establishment and its relation with successional trajectories and flammability.

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

Yes, we used the logo in the preliminary report we wrote for the national parks, and in the talks we gave in scientific meetings. We will also acknowledge The Rufford Foundation in the manuscript that we are working on to publish the results of this project.

11. Any other comments?

We would like to thank the Rufford Small Grants Foundation for the grant received, because this was a great opportunity for us. With this grant we were able to perform really extended field work and fulfill the task of sampling at a landscape level. Studies of this extent are lacking in Patagonia mostly due to an absence of budget and we were successfully able to accomplish it thank to the RSGF. We believe that In order to understand fire behavior and its implications for vegetation recovery and fire feedbacks we need more studies at this broad scale. Moreover, thanks to this project we were able to establish a strong relationship with some members of the national park staff and exchange ideas. Accordingly, we plan to continue working with them.