

Conservation and restoration of Puffball fungal diversity in *Polylepis* forests, Argentina

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Brief background and summary of the project

Polylepis forests are endemic forests of tropical and subtropical mountains of South America. These forests harbor a unique ecosystem with a high proportion of endemic taxa and include the highest forests of the world. The long-lasting land use history of the South American high mountains has fundamentally changed the appearance of the landscape and has greatly reduced forest extension. The use of fire to promote grass re-growth, domestic animal browsing, the use of wood, and soil erosion has reduced these forests to small isolated forest patches.

Relatively little is known about the ecology and management of *Polylepis* forests. *Polylepis australis* also known as "Tabaquillo" is an endemic treeline species of the mountains of Central and Northwest Argentina, and as occurred with most of the species of the genus, in central Argentina their populations have greatly declined. However, extensive wooded areas still remain.

Several endemic fungal species were recently described for these forests. Although Conservation and restoration of the fungal diversity and the associated processes are important due to ecosystem functioning, the unseen world of organic material decayers is not taken into consideration; to the point that we believe the present proposal is the first Fungal Conservation project in Southern South America. Thus, in this way the development of a project on Fungal Conservation and student training is very important.

At the end of this project trained students are able (1) to continue the present proposal, assessing the Puffball fungi diversity changes, (2) to start and develop their own new fungal conservation projects in Argentina and in the Andean countries, involving new functional and/or taxonomical groups, (3) to train park rangers and conservationists working in the areas about fungal processes and diversity conservation and (4) to perform further studies on isolation and inoculation of leaf-litter with local species. This project is the first link in a training chain of students and leaders on fungal conservation. Disclosure and educational material development (printed-digital-web) included in the project has been distributed in order

to inform and involucrate people about fungal conservation. In order to involve more people in fungal conservation and share this conservation project with the mycological scientific community, the results were presented at the VI Congreso Latinoamericano de Micología, Argentina 2008.

OBJECTIVES

The main objectives of our project were

- ✓ To know diversity of Puffball fungi of *Polylepis* and its relationship with forests conservation situation.
- ✓ Inoculums development.
- ✓ Evaluation of macrofungal diversity in reforested areas.
- ✓ Fungal Conservation Websites.
- ✓ Educational activities and materials.
- ✓ Human resources formation.
- ✓ Presentation at VI CLAM (Latin-American Mycological Congress)

SYNTHESIS OF MAIN RESULTS

Puffball Fungal Diversity

To assess Puffball fungal diversity several samplings were done. The following two different kinds of samplings were carried out:

- 1) Floristics samplings (random samples covering a wide area of distribution of *Polylepis* forests in Córdoba mountains)
- 2) Systematic sampling in established plots to explore the relationship between fungal diversity and forest conservation.

Seventy plots of 30 x 30m were sampled. Forty-eight plots in different structured/conserved woodlands, 12 in surrounding grasslands and 3 in different age reforested/restored areas).



Results show that fungal diversity depends on forest structure/conservation, being lower in degraded and disturbed forests.

We also evaluated the microhabitat preference of species for fruiting. For each specimen found, a plot of 1m x 1m was located. Structural variables, such as leaf litter cover, grasses, exposed soil, exposed rock and ferns, were recorded. With statistical multivariate techniques we were able to interpret microhabitat preference of species.

The puffball fungal diversity showed to be higher than expected. We could identify 32 species associated to the forest and neighboring areas. 296 specimens were collected and deposited in the Herbarium of the Universidad Nacional de Córdoba (CORD). 34 % of the species (11 out of 32) were novelties. Seven species are registered for first time in the region, and 4 species are new to science.

Among new species found we are working in describing *Lycoperdon sp. nov.* (right picture), that will be named "ruffordii" in acknowledgment to Rufford Small Grants. This species is the only Puffball that develop basidiocarps up to 4 meters up on the trunks of dead and living *Polylepis* trees. It is easy to observe rhizomorphs between bark layers. This behavior seems to be an advantage for dispersion of spores.



Inoculums development



Initially we proposed to isolate species present in mature forests in order to explore the possibility to be inoculated when not registered in reforested areas. However isolation of fungal strains and development of inoculums were only possible, at the moment, for *Lycoperdon sp.*

Strains were isolated from mycelial cords. Now they are subjected to molecular studies to confirm its condition of new species. Dr Mario Saparrat is now starting studies and essays on decay capabilities of this species.

Evaluation of macrofungal diversity in reforested areas.

This objective was not proposed nor budgeted in the original proposal.

After 12 years of reforestation efforts conducted mainly by Dr Renison, our team decided to evaluate changes in fungal diversity (all groups of macromycetes, not only Puffball fungi).



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We compared reforested areas, with mature forest (right picture) and with degraded areas that showed similar conditions to the previous states of reforested areas (left picture, below). In each situation 5 plots of 25m² where established seasonally. Species richness and abundance where registered. And also chemical analyses of soil properties for each plot were performed.



The next and last sampling date, corresponding to spring, is programmed for the beginning of December 2008.

Preliminary results show differences in diversity among three situations, being higher in the forest, intermediate in the reforestation and lower in degraded areas.

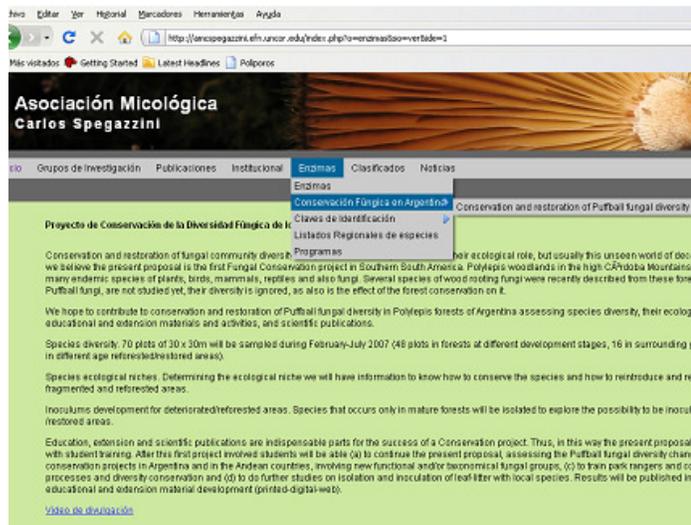
These preliminary results suggest that fungal diversity seems to be in process of recovery in reforested areas. In this way, reforestation seem to be an effective strategy to recover fungal diversity in *Polylepis* forests.

Fungal Conservation in the Web

A “**Conservación Fúngica en Argentina**” website was created and located in the webpage of the Asociación Micológica Carlos Spegazzini (<http://amcspegazzini.efn.uncor.edu/>)

In order to guarantee the perpetuation in the future of this site, we installed a server with high capacity, specially destined for this purpose.

Thanks to the Centro de Cómputos de la Facultad de Ciencias Exactas Físicas y Naturales, Universidad Nacional de Córdoba, server is actually connected and properly functioning.



We started to upload some information to the website. However, we are “checking” process of the background design of the database. Progressively all the products developed in the project will be uploaded to be available for free.

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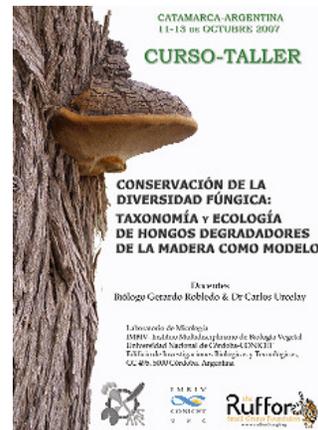
Educational activities and materials

We developed some didactical materials that were used by students in workshops.

A special Workshop was given to a group of young students starting with mycological studies and Projects, for which we prepared a special manual.

During 3 days we were interacting with students teaching theory and discussing how to perform mycology in the Laboratory and in the field.

A small guide to interpret the fungal diversity in the field was prepared. It was used during workshops and was freely distributed. Below, there is a picture during a workshop with students of Tourism guides Career and Park rangers.



A Video about the project was constructed. Actually is available in the "Conservación Fúngica en Argentina" website, however throughout Youtube (<http://www.youtube.com/watch?v=cMxiri4VxXI>) Coming soon the software to see audiovisual files will be incorporated to our website.



With pictures and music, students and volunteers developed this first version with the intention to show the efforts, activities and results of almost 2 years of work.

Human resources formation

One of the main results of this project was the students training.

Two students developed their final works of the Biology Career within the objectives of this Project. Puffball fungal diversity of *Polylepis* forests and its relationship with forests conservation situation constitutes the final work of the student Luciana Hernandez. Evaluation of macrofungal diversity in reforested areas constitutes the final work of the student Ana Gallo.

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Two students of Andean countries were *Polylepis* forests are of great importance, received one month of training in our Laboratory. Kenia Pinto (La Paz, Bolivia, right picture) and Maibe Olivera (Cusco, Peru, left down) worked in the field as in the Herbarium and Laboratory.



This fact is of great importance, because in their countries the mycology and mycologists are practically absent.

Presentation at VI Congreso Latinoamericano de Micología.

This Congress (www.almic.org) was focused on the “challenge of biotechnology and Biodiversity conservation” We presented 5 works (4 panels, 1 oral). Our presence was widely recognized as a pioneer in fungal Conservation, and we could establish several contacts with other students of Latin America that want to do similar projects on Conservation.



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FINAL REPORT FORM

The Rufford Small Grants Foundation Final Report

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

We ask all grant recipients to complete a Final Report Form that helps us to gauge the success of our grant giving. 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. 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	Gerardo Lucio Robledo
Project title	Conservation and restoration of Puffball fungal diversity in <i>Polylepis</i> forests, Argentina.
RSG reference	13.10.06
Reporting period	February 2007- November 2008
Amount of grant	£ 5000
Your email address	glrobledo@yahoo.com.ar
Date of this report	17/10/2008

1. Please indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.

Objective	Achievement			Comments
	Not	Partially	Fully	
To know diversity of Puffball fungi of <i>Polylepis</i> and its relationship with forest conservation state.			✓	
Inoculums development		✓		Only 1 species was isolated.
Evaluation of Reforestation <i>Not initially proposed nor budgeted.</i>		✓		The last sampling will be done during the beginning of December.
Fungal Conservation Websites			✓	1 server of exclusive use for the website Asociación Micológica Carlos Spegazzini and Fungal Conservation in

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				Spegazzni and Fungal Conservation in Argentina section. Coneccion thanks to Univ. Nac de Córdoba.
Educational material			✓	1 guide, 1 manual, 1 audiovisual, 1 interactive CD in construction
Human resources formation			✓	4 students involved, 2 of them develop their final works of Biology Career.
Presentation at VI CLAM. (Latinoamerican Mycological Congres)			✓	5 works presented

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

The identification of some species has been difficult and took more time than programmed. Isolation of strains was more difficult that expected. Only one species could be isolated.

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

Research:

This is the first research on fungal conservation in Argentina, and, to the best of our knowledge, in South America. It constitutes a reference project regarding South American Mycology. With our results now we could show how we are losing “invisible” biodiversity. We could show how Fungal Diversity decreases with forests degradation, and how conservation and reforestation permits recover the lost diversity.

We also found a high richness of species, including 4 new species to science. Near 300 specimens were collected and now integrates the Mycological collection of the Museo Botánico of the Universidad Nacional de Córdoba.

Human resources formation

Within this project 2 students are developing their final works of Biology career. Two students of countries where Mycology is not developed took tutorships in our Laboratory. Now, they are able to start their own research projects in their countries. The team of the project acquired experience into develop a project in Fungal Conservation.

Educational activities and materials:

Workshops and the educational material were really satisfactory. Guides and Manual developed are free distributed. The audivisual developed and uploaded to the web is a way to reach many interested people.

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

Students were really interested and participate actively in workshops. With materials given by us they could develop preliminary researches on Mycology.

Besides, computer´s technicians of the University were interested in participating from their position , doing possible the installation and connection of the server and website.

5. Are there any plans to continue this work?

Yes

This first Project permitted to establish the baseline regarding human resources, ideas and equipment. We are planning to continue research, training and communicating knowledge about Fungal Conservation in Argentina. Nowadays a project for 2009-2010 is

being constructed, including new protected areas, new fungal groups, more students and more educational activities.

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

One of the objectives of this project was to share and make freely available the results developing useful tools for Fungal Conservation. In this way the development of a website was successful product of the project.

Two educational materials (field guide and manual) has been used in workshops, and distributed among students, naturalists and Park rangers. In addition, they are freely available in our website.

We also developed an audiovisual, actually available in the Fungal Conservation Website (throughout Youtube).

Results were also presented and shared with Latin-American mycological (“scientific”) community during the Latin-American Congress of Mycology (www.almic.org). These preliminary results well be conform manuscripts for publication in peer-reviewed journals.

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

The timescale originally proposed was February 2007-Julio 2008. Field Work was done in time. However identification of species was difficult and took more time than estimated and consequently delayed all subsequent activities. However we feel that the richness of species founded in these forests compensate the delayed.

Isolation attempts and activities related to the development of the website, and installation of the server in the University net, also more time than estimated, but now are finished.

The inclusion of the new objective (evaluation of macrofungal diversity on reforested areas) involved more samplings trips not initially include in the original proposal.

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.

1£ = \$6.035 at the beginning to \$4.98 at the end of the project

ITEM	Budegeted amount	Actual amount	Diference	Comments
Field and Laboratory work	880	1000	-120	New samplig trips and soil analisys wher included. An electric generator for workshops (used of notebook and projector) and batteries charge for gps was acquired.
Sampling trips	480	550	-70	
Field Equipment	350	400	-50	
Culture media elements	50	50		
Workshops and education	3250	3250	3250	A laser printer was acquired.
Pc computer, projector...	1400	1450	-50	
Booklets	300	200	+100	
CDs	150	100	+50	
Workshops	150	200	-50	
Web	400	450	-50	
Tutorships foreign students	850	850		
General expenses	870	750	+120	Vehicle maintenance and logistics expenses were reduced and partially personally affronted to compense differences in workshops and Education
Logistics	100	80	+20	
Technician salary	620	620		
Vehicle maintenance	150	50	+100	
TOTAL	5000			

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

To consolidate a Fungal Conservation Network throughout:

- ✓ Research in others fungal groups and areas of Argentina
- ✓ Adding more researchers and students to the network
- ✓ giving more training to students, Park Rangers and Naturalists
- ✓ Elaborating others educational and diffusion materials such as illustrated field guides for species identification.
- ✓ Continuing developing and uploading information in the website.

10. Did you use the RSGF logo in any materials produced in relation to this project?

Did the RSGF receive any publicity during the course of your work?

Yes,

We include the RSGF logo on two field guides, in the posters and oral presentations presented in the Latin-American Mycological Congress, and in the audiovisual (actually uploaded in Youtube)

We also designed and distributed bookmarks in the Congress, with the logo and with the link of our Project to the website of RSGF

11. Any other comments?

We would like to highlight that we are very grateful to the support received by RSG to our project. With this support we now conform a baseline of people, ideas and equipment for Fungal Conservation in Argentina that will continue growing.

12. I agree to this report being published on the Rufford Small Grants website

yes

Signed (or print name)_

