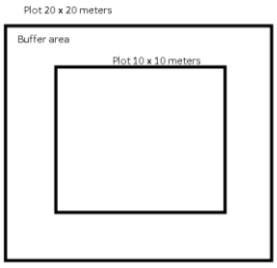
Final Evaluation Report

Your Details	
Full Name	Ángeles Fiorella Raffo
Project Title	Ecological restoration of Chaco Serrano forest invaded by *Ligustrum lucidum* (glossy privet) in central Argentina.
Application ID	40770-1
Date of this Report	01/2025

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
Selection of sites for establishing plots			x	We identified areas with different degrees of invasion through satellite images and field exploration within "Los Quebrachitos" Reserve.
Collection of seeds and sapling production			x	During February-May (summer-autumn), we collected seeds from 5 native species (*Lithraea molleoides, Celtis tala, Ruprechtia apetala, Senegalia praecox* and *Schinus fasciculata*). We produced a total of 900 saplings.
Plot establishment at field			x	We established 100 plots (10 x 10 m) ranging 0-100% of *L. lucidum* invasion. In each plot, we recorded topographic and vegetation characteristics. At each plot we counted the number of *L. lucidum* trees bigger than 20 cm in diameter. As was suggested by the PhD advisory committee, we made some changes in the experimental design. We selected a total of 60 plots (10 x 10 m) to carry out the mechanical control experiment. At each plot, we randomly assigned one of the following three treatments: (1) cutting of timber trees, we cutted all L. lucidum bigger than 20 cm of diameter (20 plots); (2) cutting of all invader trees, we cutted all the individuals of all exotic woody species (20 plots); (3) without cutting, no intervention (20 plots). The 60 plots

				were established covering a wide range of invasion and taking into account the reserve and landowner permits to carry out the cutting tasks. The size of cutting plots was 20 x 20 m in order to establish a buffer area surrounding the monitoring plot of 10 x 10 m (Fig. 1).  Figure 1. Size and design of experimental plots (treatments 1 and 2). Cutting plot: 20 m². Reforestation and ecological restoration plot: 10 square meters.
Mechanical control of timber individuals			x	For cutting *L. lucidum* trees, we hired a small local business made up of people with experience in forest fire management and in maintenance of urban forest (https://www.instagram.com/sacha.arborismo/reel/C-tJJJlR48z/?__d=1%3Futm_source%3Dig_embed). We also made some cutting tasks of small individuals with manual tools and volunteers. The cutting tasks were made during 24 days distributed in four months. At each cutted plot, we recorded the number and size (diameter and longitude) of cutted trunks, number of people working and costs of each day. After cutting (40 plots), we hired a small local business for loading, transporting and unloading in a sawmill. We only transport around 61% of cutted trunks due to topographic difficulties and high

				cost of these tasks. Thus, we tried to represent a wide range of cutting situations: different degrees of invasion, sizes of trunks, distances from the plot to the truck. We achieved a total of 9 trips and transported a total of 36 m^3 of *L. lucidum* timber. These tasks (cutting and transportation) were developed during 6 months and accounted for 72% of the total cost of the project.
Planting of native species in controlled plots		x		Due to some changes in the experimental design such as a larger number of plots and a larger area of cutting per plot that delayed the development of the project, we did not carry out the experimental plantation yet. However, we produced the saplings (900 saplings of five tree species) which are in the greenhouse and they will be planted the last week of February and first week of March. We will plant 900 saplings (180 per species) per plot in a half of the plots assigned to each treatment (6 saplings x 5 species x 3 cutting treatments x 5 plots). Also, in late summer (February) weather conditions are most appropriate for planting, as we observe in previous experimental plantings.
Short term monitoring		x		We made the first monitoring during month 12 of the project. Survival variables and damage to native trees caused by cutting tasks were recorded.
Monitoring and record		x		The monitoring of native forest recovery and survival of *L. lucidum*

				will be continued in the next months. Also the plantation and monitoring of survival and growth of saplings, as they are part of my PhD thesis.

2. Describe the three most important outcomes of your project.

a). This is the first research and ecological restoration project that assesses the effect of mechanical control on native forest recovery and, at the same time, evaluates the amount of timber from exotic trees and the costs of carrying out the mechanical control in a wide range of invasion situations. Even we still did not analyze the data we can make some important preliminary results as:

1. Timber volume that we obtained in the most invaded plots (more than 80% of L. lucidum cover) was three fold higher than in plots with less than 80% of invasion (Fig. 1).
2. The cost in terms of time and money for cutting trees was also three fold higher in the most invaded plots (more than 80% of *L. lucidum* cover) than in plots with less than 80% of invasion (Fig. 2 y 3).
3. In the less invaded plots (lower than 20%) the cost of cutting trees was too high, but the volume of timber was almost insignificant (Fig. 2 y 3). In consequence, the cost of extraction per m^3 was cheaper when the invasion was more severe (Fig. 4).

b). After the first surveys, we expanded the concept of timber individual to trees with a diameter less than 20 cm at base. This involved more cutting and transport work but reduced the amount of waste on the ground.

c). We consider that our project represents an important contribution to public politics regarding invasions in the region. Currently, the provincial government is facing an ecological restoration program and receiving contributions of knowledge from many sectors including NGOs and science-technology institutions.

La Provincia destina 100 millones para impulsar proyectos de restauración ecológica

*At the end of this report, graphics of each stage of the project are attached.

3. Explain any unforeseen difficulties that arose during the project and how these were tackled.

Even though we involved the Reserve Los Quebrachitos from the beginning of the project, we spended a lot of time making agreements with the reserve management staff and landowners before carrying out the mechanical control and timber extraction. Although the problem of invasion of *L. lucidum* is severe and the park rangers usually make exotic plant control, we observe certain resistance to cutting down trees. We overcame this aspect by talking with all the stakeholders, visiting their properties, explaining the aims and the importance of the project.

Regarding mechanical control, it was made during the dry season in which forest fires are frequent in our region (August-September). Thus, the mechanical control was a little late due to firefighting tasks carried out by the team in charge of the cuts. Regarding the transport of the timber, it was difficult to find workers, due to loading and unloading of trunks required a lot of strength from the workers, and endurance of the freight truck; both due to the topographical characteristics of the mountain region (slopes and rocks), the distances of manual transportation and the weight of the timber. So, we decided to transport only a part of the trunks trying to represent a wide range of difficulties, size of the trunks and distances, but avoiding the most difficult plots located in heavy slopes.
So, some difficulties arose during the projects but they were successfully overcome.

4. Describe the involvement of local communities and how they have benefitted from the project.
Local community benefited in several ways from the project. Firstly, we contributed to the mitigation of the invasion in the local Reserve, which is important for the preservation of water resources and the maintenance of native diversity . Secondly, both mechanical control and transportation tasks were in charge of local people, which provided a source of income. The Siempremonte project (https://siempremonte.com.ar/), which emerged from an alliance between various governmental and non-governmental, local and scientific institutions, obtained all the sections of *L. lucidum* trunks. These will be used for developing sustainable construction techniques and as an input for local sawmills and carpenters (i.e. local handicrafts, lathe parts). Thirdly, the establishment of the 60 permanent experimental plots will allow us to obtain a lot of information about the response of native forests to invasion control actions. It will allow us to make recommendations for forest management in the reserve, both in public and private areas. I highlight the educational aspect of our project as the establishment of permanent plots distributed in the reserve is allowing local people to be in contact with our research and to see the recovery of native forest.

5. Are there any plans to continue this work?

For the next three years, I will continue developing my Ph.D. in Agricultural Sciences, which involves monitoring the permanent plots that I established during this project. I hope my Ph.D. results will contribute to the mitigation of woody plant invasion in central Argentina by designing strategies of control, management, and utilization of *L. lucidum* timber.

6. How do you plan to share the results of your work with others?
I have already shared my project in different scientific-political conferences:
-Virtual seminar: management of biological invasions. 10-2024. Organized by Nodo Centro de la Red de Restauración Ecológica de Argentina (Red REA - Ecological Restoration Network).
- Speech during the local meeting "We are Earth, We are Life" 08-2024, organized by Nativas de Caroya.
-The 4th edition of the World Circular Economy Summit 2024 (06-2024) is organized by the Municipality of Córdoba.

In the future, I plan to show the results of the research through other workshops aimed at the local population of the city of Unquillo and neighboring towns. Also, we plan to communicate the results of our research in scientific journals.

7. Looking ahead, what do you feel are the important next steps?
The most important next step is to continue monitoring the progress of the permanent plots and analyze the data we are obtaining. This is very important to understand native forest response to control techniques and to optimize it.
Then, I must develop workshops indifferent localities with the same invasion problem w to share our results and to provide technical advice.
Finally, we expect to do similar experiments with other invasive species such as *Ulmus minor*, *Morus alba* and *Melia azederach*, which are affecting wide areas and seem to have timber with potential application in construction.

8. 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, I used the Foundation logo on all occasions in which I presented the project, including the above mentioned speeches and the I International Symposium on Ecological Restoration Practices Argentine Ecological Restoration Network (https://enrea.com.ar/), where I presented two posters.

9. Provide a full list of all the members of your team and their role in the project.
Romina C. Torres (PhD in Biological Sciences), is a researcher at the Instituto de Investigaciones Biológicas y Tecnológicas (CONICET-UNC) and a professor in the Centro de Ecología y Recursos Naturales Renovables (FCEFyN-Universidad Nacional de Córdoba). She is my supervisor in my PhD thesis. She participated in the experimental design and field surveys, mainly in the ecological aspect. As a member of the Restoration Ecology Network of Argentina (Red REA: www.redrea.com.ar), she contributed to spreading the project in restoration meetings and contacting people who work in invasion control. Also, she contributed looking for students who help in the surveys as volunteers.

Valeria Fenoglio (PhD in Architecture Sciences), is a researcher at the Centro de Investigaciones y Estudios sobre Cultura y Sociedad (CONICET-UNC). She is an architect and specialist in the development of new technologies for addressing habitat production. She participated in the design of the surveys selecting the characteristics of the trunks to be wooded and transported. She was responsible for contacting people who received the timber after cutting, including local carpenters and handicraft workers. She also helped in the meetings with the reserve managers and landowners.

Sara M. Boccolini (PhD Phil. Urban and Regional Studies) is a researcher at the Centro de Investigaciones y Estudios sobre Cultura y Sociedad (CONICET-UNC). Her work is oriented towards the study of regional urbanization processes and sustainable and inclusive urban development. Sara contributed to this project by mapping affected areas using remote sensing (processing Landsat and Sentinel images with GIS software) and producing reference maps that will classify land cover according to different levels of invasion by exotic species.

Georgina Rovaretti (Graduate in Agroecology), is a PhD student, her work is focused on the study and support of productive processes related with socio-environmental sustainability. Her main contribution to this project is the raising of local knowledge on the use of *L. lucidum* and the comprehensive analysis of environmental problems and the regulatory framework at the provincial level.

Pilar del Campillo (Arquitecta) is a PhD student, her work is focused on: socio-productive potential of invasive exotic species timber (*L. lucidum*) as a contribution to the regenerative production of the habitat in the region. Case/Experience: "Siempremonte Project", directed by Dr. Architect Valeria Fenoglio.
Pilar and Georgina participated in field surveys: measurement and recording of variables, classification of logs, help in logistics for loading, transfer and disposal of logs.

Research assistants are students from the Faculty of Ciencias Exactas, Físicas y Naturales of the UNC who have carried out their assistantship tasks in my research project:
Lorena Pari
Valentín Grisanti
Oriana Koestler
Fatima Barrionuevo
Santiago Fowler
Manuel Ferreyra
Leonardo Rincón
Rocío Sandoval
Brisa Castillo
Augusto Rodríguez
Brisa Rodríguez Paz
Vanina Koch
Fernando Navarro Domingo
Camila Rivera Caisutti
Florencia Mellia

Other participants:
Cooperativa Proyecto Hormiga: resource management, seedling production, sampling.
Ana Vazquez, Fabricio Tazzioli, Diego Dragotto, Sebastián García, Arie Herrera, Inti Naparstek, Catalina Campagnon, Juan Pablo Moreno y Fabián Bonomi

University Technician in Park Ranger, Provincial University of Córdoba.
Samanta Egea: sampling with registration and measurement of variables in the field.

10. Any other comments?

The Rufford Foundation funding was crucial to meet the objectives of the project, particularly the most difficult ones: cutting, loading and transporting the timber. Despite the changes in the experimental design meant an increase of the total

number of cutting plots and the plot size and, in consequence, increased the effort , and the difficulties related with permissions, the activities of the project were successfully achieved.
The only pending activity will be carried out in February 2025. Also, we will continue the monitoring of the projects in the next months.
For these reasons I consider that the results have been very successful, more than I expected.

Figures

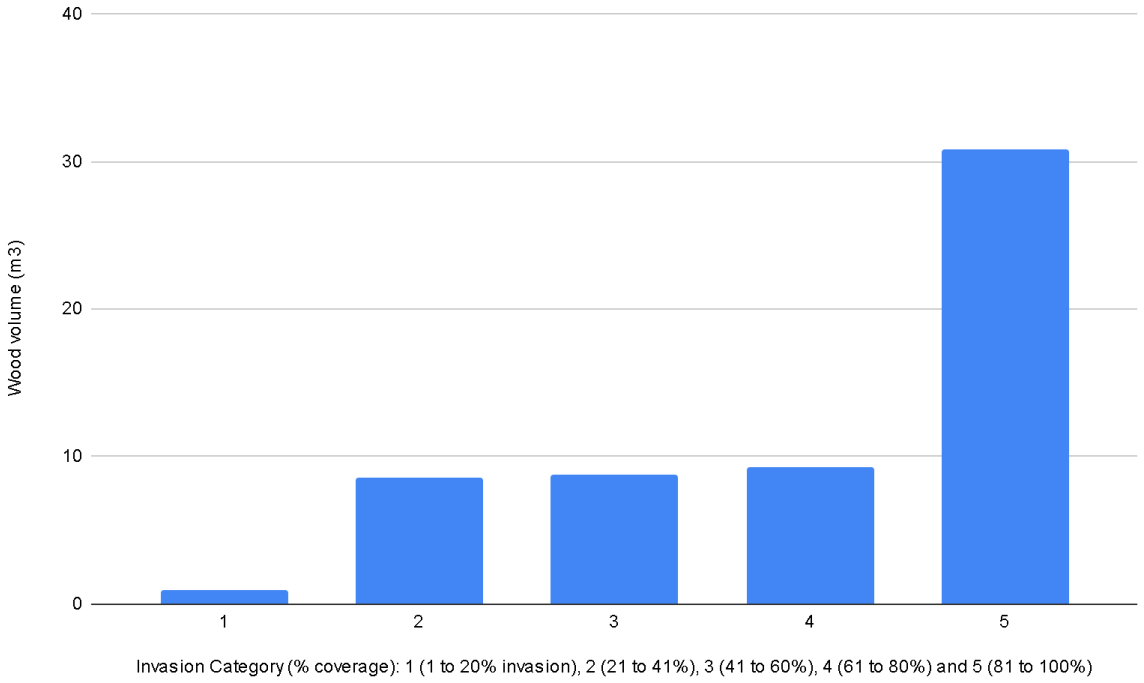


Figure 1. Wood volume according to invasion category.

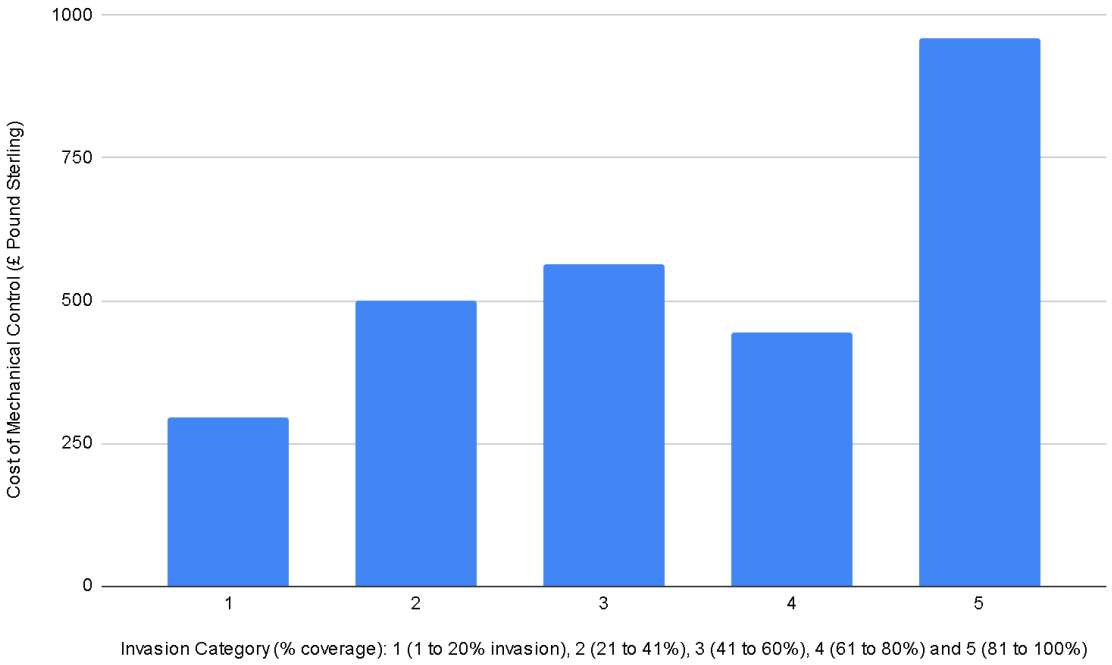


Figure 2. Total cost (pound sterling) of mechanical control, according to the proportion of *L. lucidum* invasion. In each invasion category, the total area intervened was 400 m2·

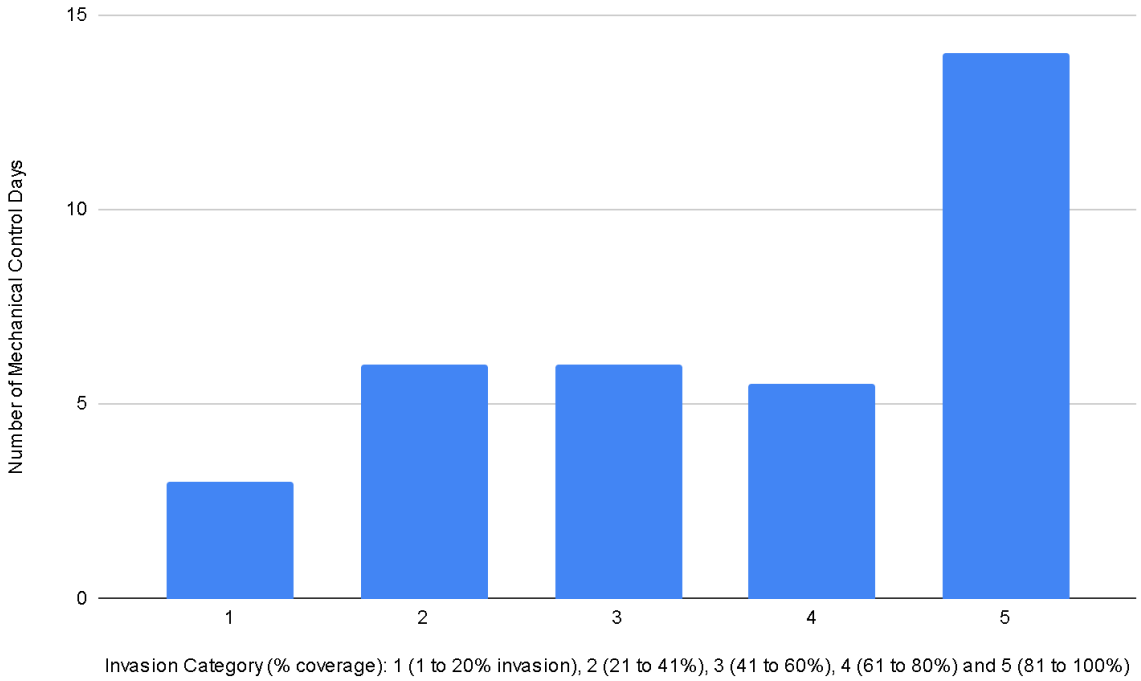


Figure 3. Number of cutting days according to each invasion category

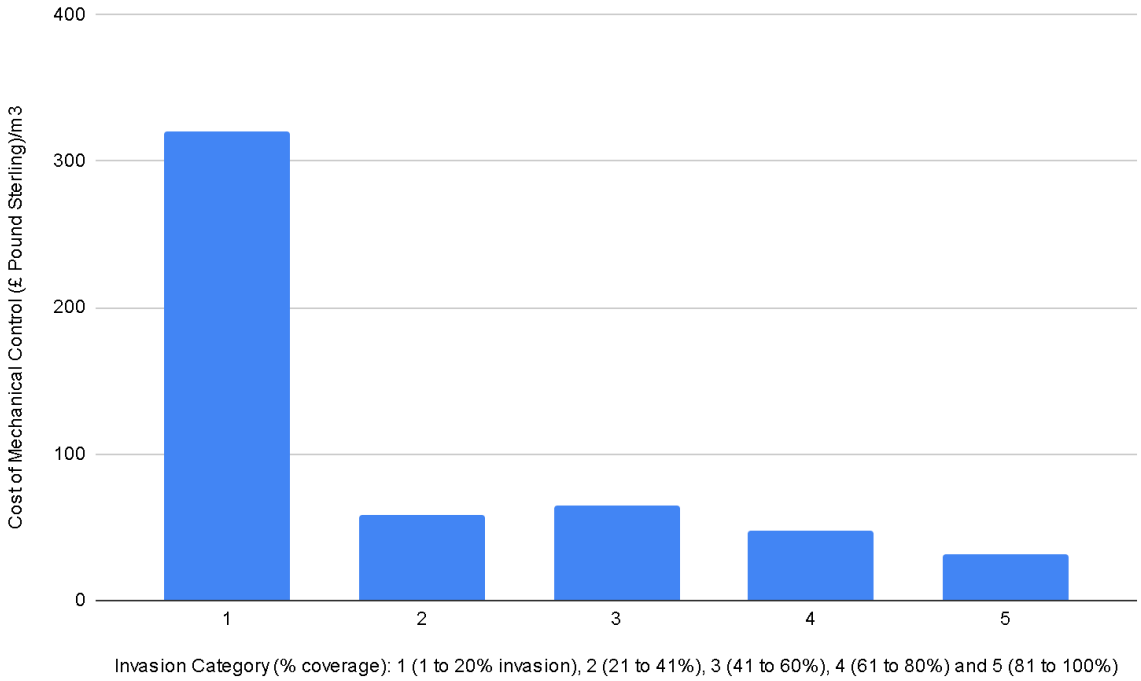


Figure 4. Cost per m3 of timber according to invasion category.