Project Update: November 2023

Results Workshop

I was able synthesise the results of the first 2 years of this project into concrete recommendations in an oral presentation given to local government and industry professionals, landowners, and local NGOs. The presentation was also open to the general public. The audience was engaged and interested and was pleased to receive concrete recommendations on how to improve the success of post-fire forest restoration efforts. Rufford funds helped to pay for transit to the event and to make refreshments available for audience members.

The community outreach event was well received and attended at a local event hall in Ushuaia, Argentina.

Soil Analyses

In phase one of this project, we measured tree regeneration in 384 subplots that were tied to 192 macroplots. In our larger plots, we measured a series of variables which included plot elevation, slope, aspect, distance to mature live trees, regeneration microsite abundance, and more. As the final step in this part of data collection, we collected soil samples from each of our 192 macroplots across our eight research sites in four fires. Collecting soil using a special cylinder, we weighed soil samples upon arrival to our lab in Ushuaia and after drying we reweighed these samples to determine their moisture content. After passing the samples through various sieves, we moved forward with pH and organic matter measurements and found that recently burned soils were more acidic and had substantially more organic matter than unburned soils. Recently burned soil was also significantly denser than unburned soil. Over the winter (southern hemisphere), we conducted our final soil analyses to quantify nitrogen, phosphorous, and

carbon, which also revealed substantial differences between burned and unburned soils in terms of their nutrient contents.

Spring Planting – Restoration Project

The Arakur hotel in Ushuaia owns several hundred acres of land, a significant portion of which was lenga forest that burned in the early 1900s. Much of this burned area has not returned to forest approximately 100 years after it burned and is instead a grass/shrubland. The hotel's owners agreed to house a restoration project in this burn scar that implements lessons learned from my thesis and related projects. In April 2023 (autumn), we transplanted half of approximately 2,000 tree seedlings selected from healthy adjacent forests with abundant regeneration to the burned area. In October 2023, we transplanted the other half of the seedlings and will compare survival rates between these two common planting seasons. We utilised a variety of planting techniques and sites when transplanting groups of individuals (with/without herbivore protection and with/without protection via downed logs, for example). Volunteers from the local community assisted in the planting event. Not only will this project result in the restoration of approximately eight acres of forest that would otherwise likely be permanently lost, but it will also provide concrete validation of the effectiveness of different restoration strategies. Rufford funds were used to buy planting stakes, fencing and rebar to construct metal plant protective structures, tags to mark planting sites, metal wiring, meals for volunteers, and for fuel to go to and from the project site.

A lenga seedling being removed from a healthy forest with abundant regeneration (top); our crew planting seedlings in the burn scar (bottom).

Conference and Publication Update

With the support of The Rufford Foundation, this project has generated a tremendous amount of novel data that helps describe the response of *Nothofagus antarctica* and *N. pumilio* to wildfire and how best to actively restore these forests post-fire. We were able to publish two peer-reviewed articles based on our work in this project that were published in the journals "Forestry" and "Frontiers in Ecology and Evolution", and we also wrote a "pop science" article for the general community that appeared in a magazine that is distributed throughout Tierra del Fuego (pictured below). We were also able to present some of our results from this project, specifically on the impacts of forest fires on soil changes, at the "XXX Reunion Argentina de Ecología" in Bariloche, Argentina. Rufford funds were not used to attend the conference but were of course essential to collecting the data behind our presentations and posters. Results derived from this project are generally being well received by both the scientific and non-scientific community, as both groups are increasingly concerned about how wildfires impact the sensitive forests and dependent flora and fauna of southern Patagonia.

Cambios en el suelo post-fuego afectan plántulas de *Nothofagus* en Patagonia Sur

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Contexto

Los incendios pueden producir cambios drásticos en las propiedades de los suelos forestales. En Tierra del Fuego, Argentina, estos cambios pueden acentuar ciertas limitantes naturales e impedir la regeneración natural de árboles nativos.

Objetivo

Objetivo: evaluar cambios en el suelo producidos por fuego y sus impactos sobre la regeneración de *Nothofagus antarctica* (ñire) y *N. pumilio* (lenga).

Métodos

- Se establecieron 192 parcelas (quemadas = 160, controles = 32) en incendios de ~1940, 1978, 2008 y 2019 en que se sacaron muestras de suelo y se registraron plántulas (<30cm) por hectárea (Fig. 1).
- Se analizaron las propiedades del suelo por edad de fuego con GLMM y se correlacionó la regeneración arbórea con dichas variables (Pearson (r)).

Figura 1. a) Recolección de suelo con cilindro; b) muestras de suelo secándose a T ambiente; c) determinación de materia orgánica en mufla a 500° C; d) determinación de pH.

Resultados

- La densidad del suelo fue 0,35 g/cm^3 mayor en suelos quemados que en los no quemados (F=15,31; p<0,001). La densidad del suelo fue 0,82 g/cm^3 mayor (F=3,82; p=0,01) y el pH 0,5 menor (F=20,62; p<0,001) en el incendio más reciente comparado con el más antiguo.
- La humedad (F<0,001; p>0,05) y materia orgánica (F=8,2; p <0,001) fueron mayores en el incendio de ~1940.
- La regeneración de ñire se correlacionó negativamente con la densidad de suelo (r= –0.57; p> 0,001) (Fig. 2) y positivamente con el pH (r=0,44; p>0,001), la humedad (r=0,6; p>0,001) y la materia orgánica (r=0,37; p>0,001).
- La regeneración de lenga se correlacionó negativamente con la densidad de suelo (r= – 0,24; p=0,02) (Fig. 2).

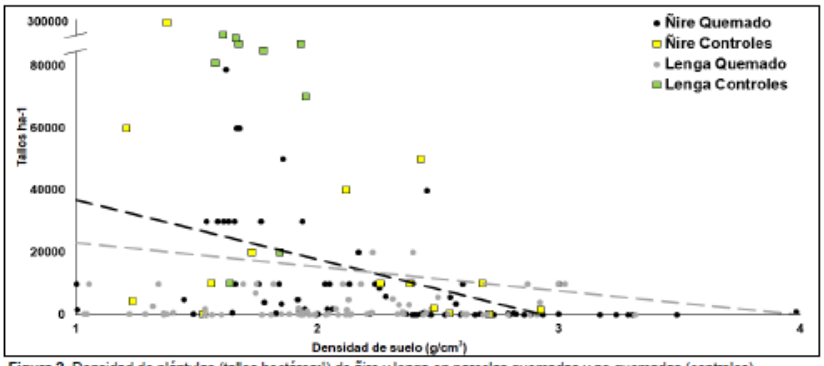

Figura 2. Densidad de plántulas (tallos.hectárea^{-1}) de ñire y lenga en parcelas quemadas y no quemadas (controles), según la densidad de suelo (g/cm^3). Las líneas representan la correlación para ñire (negra) y lenga (gris).

Conclusiones

La pérdida de estructura de suelo post-fuego incrementa la compactación del suelo, afectando negativamente la regeneración del bosque. Algunas propiedades del suelo se recuperan con el tiempo. En zonas quemadas, se deberían considerar estrategias para reducir la pérdida de estructura del suelo (por ej., cubriendo el suelo con mantillo) y aumentar la materia orgánica post-fuego.

Presenting to an audience of scientists in Bariloche, Argentina (top); poster presented at the "XXX Reunion Argentina de Ecología" (middle); cover article for the locally distributed magazine "La Lupa" (bottom).


Una revisión de la recuperación forestal post-incendio en sitios de altas latitudes
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