Project Update: February 2022

Seedling Monitoring and Care

In the initial phase of this project, my team and I transplanted some 400+ seedlings from the forest to our research station in Ushuaia. We then planted these seedlings in pots filled with burned and unburned soils. Over several days, I took initial measurements of heights, diameters, and other variables on each plant. I will repeat these measurements in the fall and spring for the next 3 years. In the meantime, I have set up probes to measure the ambient temperature and relative humidity around the seedlings. The seedlings are divided between a shade tunnel and an experimental garden, which will allow us to quantify the relative importance of soil conditions compared to climatic variables. Conditions are harsh in the experimental garden; exposure to wind and sun are intense for these young trees and I apply controlled irrigation (the same amount of water to all plants) when conditions are very dry. This controlled irrigation will help seedlings through this initial period of stress, but afterwards they will be left to fend for themselves.

Life is tough on seedlings in the experimental garden (left); we are recording the temperature and relative humidity these seedlings are exposed to on an hourly basis (right).

Soil Analysis

As part of our analysis of how burned soils impact tree survival and growth, we quantified the characteristics of burned and unburned soils. This work entailed measuring soil pH, organic matter, moisture content, nitrogen, and phosphorus. As we do not have the capacity to measure nitrogen and phosphorus in our lab, Rufford funds allowed us to send soil samples to Buenos Aires for analysis of those variables. Our initial results for pH indicate that burned soils are significantly more acidic than unburned soils. Burned soils also retain more water, as their compactness does not allow water to filter through them. Burned soils also tend to have more organic material, likely in the form of bark, branches, and leaves that were not fully consumed by fire. These results will help to contextualise the survival and growth data we collect from this experiment. It seems likely that burned soil conditions will negatively impact native tree seedlings, but we will confirm this hypothesis over the next 3 years.

Soils must be dried in special ovens (top, bottom left) and passed through sieves before we can evaluate variables of interest, such as pH (bottom right).

Field Work: Forest Recovery Measurements

With the arrival of summer in the southern hemisphere, field season is in full swing. The bulk of my data collection has occurred over the last few months and will continue as long as the weather permits. With a team of volunteers and paid assistants, I began sampling tree regeneration in burned an unburned plots across fires of differing ages. This field sampling consists of counting tree regeneration in different stages (initial, advanced, and juvenile) and describing the conditions in which this forest regeneration exists or is absent.

We observed tree seedling/sapling densities in the context of a plot's exposition to the sun, remnant woody material, trees that survived the fire, elevation, evidence of grazing, and microsite conditions, among other variables. Early observations would indicate that the presence of post-fire grazing and distance to live trees are two of the more important factors that determine whether trees can regrow in a burned area. Over the autumn and winter, I will begin to formally analyse the data collected in this phase of the project. My results will help me to create a set of guidelines that local natural resource managers can use to make more effective and informed decisions when crafting reforestation plans for burned areas. Rufford funds have been instrumental to the success of this part of my project. With the help of my grant, I have been able to pay for the fuel needed to get to my research sites and our food and supplies while in camp. Rufford funds have also allowed me to hire field assistants when my research station colleagues were not available to help.

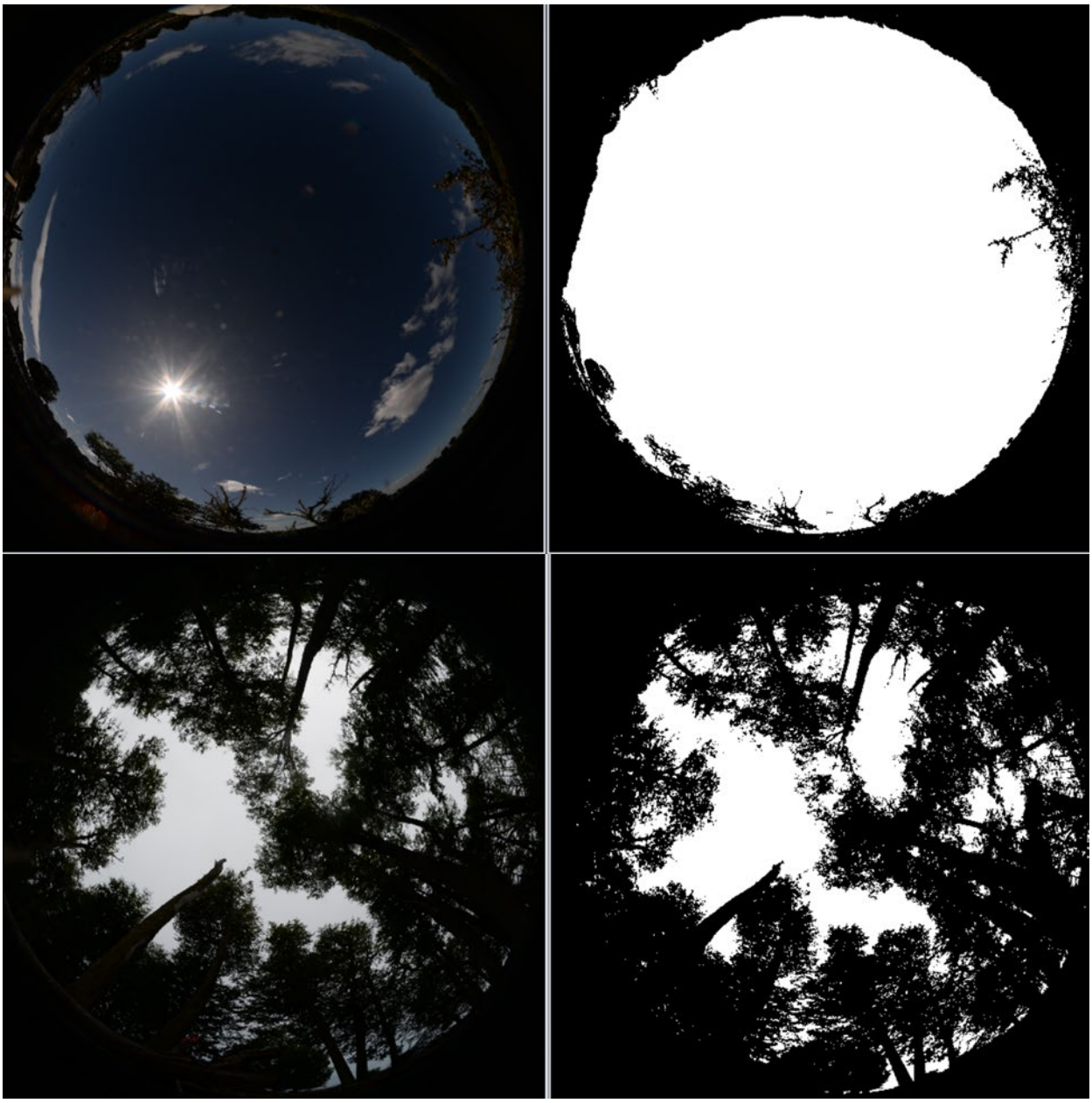
Estancia Pirinaica: my furthest study site is located 3 hours from Ushuaia at the northernmost forested extend of the island in a fire that burned approximately 70 years ago. The fire was intentionally set in the early stages of the Argentine-European colonisation of the island of Tierra de Fuego. Ranchers girdled trees, killing them and thus making them easier to burn. The ranchers then set fire to the dead forest and in many instances planted desirable foraging species such as exotic grasses across the recently burned landscape, improving grazing conditions for their sheep and cattle. Forest regeneration is sparse across much of the burned area decades after the fires.

Measuring canopy cover (left) and checking the origin of tree regeneration (right), from seed or vegetative sprouting, in the burned landscape of northeast Tierra del Fuego.

An old growth lenga forest unaffected by fire (top) directly adjacent to a lenga forest that burned over 70 years ago (bottom). Sparse tree regeneration is grazed heavily by the native ungulate, the guanaco, maintaining open, savannah-like conditions and promoting a species shift to ñire, a hardier tree species. These ñire-savannahs are a human-caused condition, and they exist exclusively in burned areas.

Old-growth, unburned forest (top) compared to burned forest (bottom) as seen through a fisheye lens. We process these 180° photos with a software program that allow us to quantify canopy cover and light radiation as experienced by seedlings.

Reserva Provincial: the most visible of all the fires on the island, this burned area is only 45 minutes from Ushuaia along the main highway the goes north/south across the island. The fire was ignited in 1978; many believe it was intentionally set during a border dispute between Argentina and neighboring Chile as part of the conflict. The impact of grazing post-fire on forest recuperation is evident here. The highway cuts the burned area in half: the west side of the highway (privately-owned) was heavily grazed after the fire, while the east side (government-owned) was not. The land free of grazing has regenerated substantial forest cover, while the grazed land has converted to shrubland.



Regeneration that managed to establish after the 1978 *Reserva Provincial* fire has been grazed so persistently that many trees look more like bushes (top). When young trees are

not being grazed, they are being killed by non-native beavers; this further inhibit post-fire forest recovery (bottom).

Lote 93: this fire is located on provincial forest land. It burned in 2012. The area was forested with large, old growth lenga trees before the fire. These forests are an important resource for local forest businesses and also provide valuable habitat for local fauna. Regeneration is thick around the borders of the burned area, but non-existent toward the interior of the fire. Provincial foresters have already started a pilot reforestation project here, having planted several thousand trees last spring. Still, much of this 7,000 ha fire remains barren of tree regeneration. When my study results are finalised, I hope to work closely with local foresters to help them implement more effective and informed regeneration strategies at *Lote* 93.

A patch of unburned forest (left) only 150 feet from a spot with 100% tree mortality (right) in the *Lote 93* fire.

Lenga Patagonia: my most recently burned study site is located on the grounds of a large forestry company. Fire escaped from their sawmill in 2019 and spread rapidly for several days before wet conditions slowed the blaze. Given the recent age of this fire, regeneration is sparse. The forestry company responsible for the fire is legally obligated to replant the burned area. I have begun working with the company's head forester to craft their restoration plan.

The Magellanic woodpecker (top), typical of unburned forests on the island, was seen only several miles from the Lenga Patagonia fire where what was once open forest may transition to pastureland (bottom), favoring exotic species like wild horses over the emblematic, native woodpecker.

Collaboration with Local Business:

I have engaged the local business, Neurona, to help with my field work. My field work requires a team of at least three individuals to complete and my colleagues are not always available to help in the field. For additional help in the field, I reached out to local business owner Mr Francisco Mattenet, who is a renewable natural resource engineer. He is the owner of a small, local business that uses the extracts from the leaves of ñire trees to produce teas, creams, and liquors. His company is actively involved in preserving the health and vigor of the island's native forests, as the quality of his products depends on the conservation of old growth, ñire forests. Through Neurona's social media page and an appearance on local television, we have been promoting the importance of my research and of forest conservation and restoration.

Neurona Ushuaia
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¿Como se recupera el Bosque después de un Incendio?🌳🌳🔥🔥🔥🌱🌳🌳🌳🌳

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Esto es lo que está estudiando, Matthew Ruggirello Investigador recientemente llegado de EEUU que trabaja en el CADIC Ushuaia. Desde Neurona queremos agradecer la invitación a poder colaborar con esta investigación tan importante para el cuidado de Nuestros Bosques Nativos.

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Matthew Ruggirello, Investigador. Nos cuentan sobre los Incendios Forestales en el Mundo y las situaciones de los bosques post Incendios, ¿SE PUEDE RECUPERAR EL SUELO? Y cuanto demoran los bosques en regenerarse.