Progress report: Post-fire architectural variations of resprouting species from northwestern Patagonia: implications for flammability and community management (ID: 45433-1).

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In this report, we summarise the activities carried out and the results obtained over the past few months with the support of the Rufford Foundation, since receiving the grant in February 2025. We also outline the planned future activities.

The species studied are four native resprouting species from Argentine Patagonia: ñire (*Nothofagus antarctica*), laura (*Schinus patagonicus*), maitén (*Maytenus boaria*), and chacay (*Ochetophila trinervis*).

- **Objective 1**

To characterise the basic architecture of the selected species at early developmental stages.

Performed activities

Between late May and June 2025, we analysed 20 two-year-old plants of the four selected species growing in a greenhouse to describe their architectural patterns (Figure 1). We retrospectively analysed the annual shoots that make up the main axes, and in detail the last annual shoot developed by the main axis.

For each individual, we recorded basal diameter, total length, number and length of internodes, phyllotaxis, axillary production of each node, and apex status. In addition, in branched plants, we analysed the position and size of the branches relative to the main axis to identify and classify the first categories of axes (Figure 2).

Results obtained

Ñire: Two-year-old ñire individuals (Figure 1) presented the following characteristics per shoot:

- Annual shoot from the previous year: average basal diameter of 11.38±3.52mm. Delayed branches in 95.83% of individuals with an average number of 5.91±0.53; no dead branches were found.
- Current annual shoot: an average diameter of 6.28±0.28 mm and length of 86.96±5.74 cm. Alternate distichous-tristichous phyllotaxis in 71% of cases and alternate distichous only in 29%. Immediate branches present in 91.67% of individuals with an average number of 13.50±1.39 distributed in general forming two groups, one located between the proximal and middle zone and the other between the middle and distal zone. Nodes equipped with a nomophyll, plus a bud or branch. The average number of internodes on the main axis was 55.83±3.04 with an average length of 1.54±0.06 cm. The apex was found to be alive in all individuals.

Laura: Two-year-old Laura individuals (Figure 1) presented the following characteristics per shoot:

- Annual shoot from the previous year: average basal diameter of 9.96±0.27mm. Delayed branches present in 82.14% of individuals with an average number of 4.35±0.43 and dead branches in 28.57% of individuals with an average number of 2.00±0.33.
- Current annual shoot: an average diameter of 7.97±0.21 mm and length of 93.18±3.25 cm. Alternate spiral phyllotaxis. Immediate branches present in 100% of individuals with an average number of 38.96±2.04, generally grouped between the proximal and middle zones of the shoot. Nodes equipped with a nomophyll, plus a bud or branch. The average number of internodes on the main axis was 101.64±3.86 with an average length of 0.92±0.02cm. The apex was found to be alive in 92.86% of individuals.

Maitén: Two-year-old maitén individuals (Figure 1) presented the following characteristics per shoot:

- Annual shoot from the previous year: the average basal diameter was 4.94±0.34mm. Delayed branches were present in 40.74% of individuals with an average number of 2.36±0.41; no dead branches were found.
- Current annual shoot: an average diameter of 4.01±0.31 mm and length of 47.38±5.14 cm. Alternate spiral phyllotaxis. Immediate branches present in 65.38% of individuals with an average number of 4.12±0.74, generally grouped between the proximal and middle areas of the shoot. Nodes equipped with a nomophyll, plus a bud or branch. The average number of internodes on the main axis was 54.23±5.34, with an average length of 0.85±0.04 cm. The apex was found to be alive in all individuals.

Chacay: Two-year-old chacay individuals (Figure 1) presented the following characteristics per shoot:

- Annual shoot from the previous year: an average basal diameter of 9.21±0.30 mm was recorded. Delayed branches were found in 82.14% of individuals, with an average number of 3.47±0.47. In addition, we recorded codominant and dominant branches with respect to the main axis in 28.57% and 7.14% of individuals, respectively. No dead branches were found.
- Current annual shoot: an average diameter of 6.19±0.26 mm and a length of 96.82±4.21 cm. Opposite decussate phyllotaxis. Immediate branches present in 100% of individuals with an average number of 31.54±3.32 without a visible grouping pattern. Thorns present in 100% of individuals with an average number of 35.57±3.42. Nodes generally provided with two opposite nomophils, each with a bud, branch or thorn (96.43% of individuals) except for the node of one individual where a branch and a bud were found emerging from the axil of the same nomophil. The average number of internodes on the main axis was

47.21±1.23, with an average length of 2.03±0.06 cm. The apex was found to be alive in all individuals.

Figure 1: Two-year-old seedlings of the selected species grown under greenhouse conditions. A: ñire, B: laura, C: chacay, D: maitén.

Figure 2: Architectural measurements conducted on two-year-old seedlings grown under greenhouse conditions.

- **Objective 2**

Architectural variation associated with post-fire responses under experimental conditions.

Performed activities

Between late February and early March 2025, we evaluated the post-treatment response in terms of architecture and flammability in approximately 60 individuals per species of the four selected species. These individuals had previously (in March 2024) undergone two experimental treatments: biomass removal with fire (through burning) and without fire (through pruning). Some were left intact as a control (Figures 4 and 5).

For each individual, we recorded: height, number of axes and total reiterations of the entire plant. Basal diameter, total length and deviation from the base of the most dominant axis. We also recorded the length, basal diameter, number of nodes and branches, and condition of the apex of the annual shoot of the main axis (Figure 3). In addition, we recorded the ability to regrow (presence of regrowth at some point during the year, even if it did not survive) and the survival of each species over the course of one year after treatment.

Results obtained

- <u>Regrowth ability and survival</u>

For all species, the regrowth ability was lower in plants exposed to fire than in plants pruned without fire. The species with the highest regrowth ability after fire were maitén (71%) and chacay (50%), in contrast to ñire (44%) and laura (20%). However, post-fire survival was higher for ñire (44%) and maitén (43%) in contrast to laura (20%) and chacay (10%).

Survival and the number of regrowths for the two treatments were positively related to the initial size of the plant (basal diameter and height), except for ñire, in which the treatment was the only significant factor. For this species, plants subjected to fire had lower survival and fewer regrowths than plants pruned without fire.

- <u>Architecture and flammability</u>

The characteristics of the last shoot or main annual reiteration (for control plants and treated plants, respectively) varied significantly between treatments (pruning, burning, and control). In general, significant differences were found between plants subjected to some form of biomass removal treatment and control plants.

For ñire and laura, the size of the shoot (basal diameter and length) was significantly greater in pruned and burned plants than in control plants, as was the number of branches. The number of nodes was significantly greater in burned plants than in control plants. For maitén, both shoot length and the number of branches and nodes were

significantly greater in pruned plants than in control plants. As for chacay, since the survival rate of burned plants was very low (N=2), burned and pruned plants were grouped together as 'treated' plants and compared with control plants. In this case, both shoot size (basal diameter and length) and the number of branches and nodes were significantly greater in treated plants.

The condition of the apex (alive/dead) did not vary significantly, except for ñire, where a significantly higher proportion of live apices was observed in burned and pruned plants.

Figure 3: Post-treatment architectural measurements.

Figure 4: Individuals of maitén (top) and laura (bottom) following one growing season after treatment application. Control and treatment conditions are indicated (biomass removal without fire: pruning; and with fire: burning).

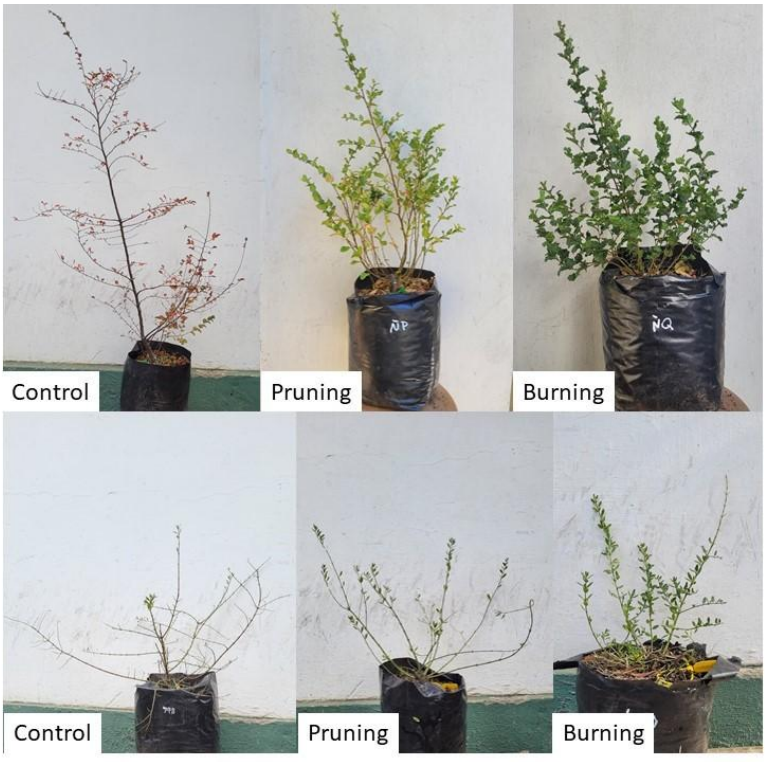

Figure 5: Individuals of ñire (top) and chacay (bottom) following one growing season after treatment application. Control and treatment conditions are indicated (biomass removal without fire: pruning; and with fire: burning).

- **Objective 3**

To characterise the basic architecture of the selected species at advanced developmental stages and to assess architectural variation associated with post-fire responses under natural conditions.

Performed activities

Between January and April 2025, we selected 20 individuals per species for three of the selected species: ñire (*Nothofagus antarctica*), laura (*Schinus patagonicus*), and maitén (*Maytenus boaria*). For each species, 10 individuals were located at a fire affected site, and 10 at a nearby unburned site with similar environmental conditions (Figure 6).

For each individual, we recorded general measurements including: height, basal diameter of main axes, number of axes (live and dead), axis categories, branching pattern, crown width, and height of the first branch from ground level. We then harvested one main axis from plants growing in post-fire conditions, and a comparable fragment containing the same number of growth units from the main axis of plants growing in unburned conditions, estimating the percentage of the total plant represented by the harvested portion.

For the harvested axis, we recorded general metrics such as the number of growth rings and characteristics of each growth unit (basal diameter, length, branching pattern, number and diameter of branches). We also recorded specific measurements for the two-year-old shoot (number of branches, distance between branches), and the most recent annual shoot (number of nodes, leaf area) (Figure 7).

Additionally, the harvested axes from five individuals per species were separated into fine and coarse fuel fractions, which are currently being dried and weighed (Figure 8).

Results obtained

We are currently analysing the data and finishing processing the samples.

Figure 6: Individuals of maitén, laura, and ñire growing at an unburned site (top) and at a post-fire site (bottom).

Figure 7: Architectural and flammability measurements of the harvested axis.

Figure 8: Fine fuel weighing process

- **Objective 4**

Architectural variation in response to pruning in individuals growing at early post-fire regeneration stages.

Performed activities

Between mid-April and May 2025, we analysed 45 regrown ñire (Nothofagus antárctica) individuals growing in a site affected by fire between December (2021) and April (2022). In autumn 2024, different pruning treatments were applied to the regrowth: 15 individuals were severely pruned, another 15 were moderately pruned, and 15 were left as controls without any pruning (Figure 9). Two shoots were always left intact on the pruned individuals, one was marked as a reference and the other was left as a replacement in case it was necessary.

We took measurements of each individual on different scales: entire plant (crown width, average height of the bush), marked regrowth (length, height, basal diameter) and annual shoot (length, basal diameter, number of nodes and branches) (Figure 10).

Results obtained

We have already taken all the measurements and are currently processing and analysing the data.

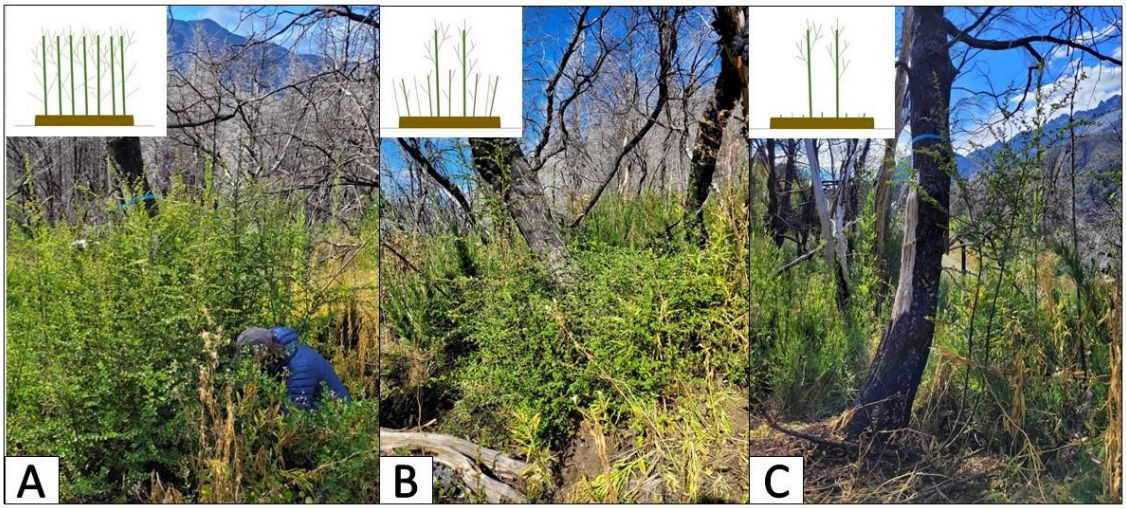

Figure 9: Pruning treatments in ñire individuals. A: control, B: moderate pruning, C: severe pruning.

Figure 10: Architectural measurements after a post-treatment growth season in ñire individuals.

- **<u>Courses</u>**
  - "START WITH R: Introductory course on data analysis and visualisation". April 2025. Duration 40 teaching hours. Universidad Nacional del Comahue, Centro Regional Universitario Bariloche, Postgraduate Department, PhD in Biology, Bariloche, Río Negro Province. APPROVED
  - 'IDEAS AND RESEARCH PROJECTS IN ECOLOGY' May 2025. Duration 40 teaching hours. Universidad Nacional del Comahue, Centro Regional Universitario Bariloche, Postgraduate Department, PhD in Biology, Bariloche, Río Negro Province. APPROVED

- **Future activities**

Most of the field and greenhouse activities have been completed. With regard to objective 1, we are currently processing the data obtained. As for objective 2, we are preparing a manuscript for publication in a scientific journal and finalising the organisation of the results for presentation at the First Tri-national Ecology Meeting (RAE, Mendoza Capital, Argentina) in October 2025. Regarding objective 3, in the next field season (southern spring 2025-summer 2026) we will complete the collection and analysis of individuals and the processing of data. For objective 4, in the coming months we will continue to process the data and investigate the results obtained.

This month, I will attend a course offered by the Postgraduate Department of the Universidad Nacional del Comahue on mixed linear models using the statistical programme R, to obtain more tools for analysing the data from our work.

Another activity planned for October of this year is to participate in “INIBIOMA Abierto”, an interactive science fair that allows the community to learn about the research carried out within the institute through activities and workshops.