DAVIS EXPEDITION FUND

REPORT ON EXPEDITION / PROJECT

Expedition/Project Title:	Chilean Expedition. *Genetics and Conservation of the Southern South American Conifers*
Travel Dates:	5th February to 19 March 2018
Location:	Central South of Chile, From the Maule to Araucanía Region.
Group Members:	Mauricio Cano, Ludovica Santilli**,** Nicolás lavandero
Aims:	Quantify level of regeneration and collect DNA samples of endemic conifers from South America.

Outcome (not less than 300 words):

THE UNIVERSITY of EDINBURGH

Genetics and Conservation of South American Conifers

ROYAL BOTANIC GARDEN EDINBURGH

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Abstract

The fieldwork took place in Chile from the Maule to Araucanía Region (35º-39ºS), from February to the end of March 2018. The focus of this expedition was to quantify the level of regeneration of an endemic conifer species from Chile and part of Argentina, from the Podocarpaceae family; *Prumnopitys andina*. The second goal was to collect DNA material of the southernmost population of the South American endemic conifer *Fitzroya cupressoides,* samples which will be included to a set of DNA samples collected from the expedition done in 2017.

During the expedition, I covered a total of 11 populations including the entire native range of *P. andina* besides the southernmost *F. cupressoides* population in Chile. The regeneration survey was very successful, extracting empiric data from each population which is now under statistical analysis to evaluate the regeneration status of the species and correlate it with different environmental variables.

On the other hand, 25 DNA samples were taken from the southernmost *F. cupressoides* population, however, due to the geographical barriers in addition to the weather conditions, was not possible to cover the entire population size, obtaining samples just for one part of the population.

The following fieldwork summary report will provide an overview of the main achievements, the information that has been taken from the field and some preliminaries results.

Introduction

The current extant conifers with 627 species are classified in eight families, Sciadopityaceae, Phyllocladaceae, Cephalotaxaceae, Taxaceae, Araucariaceae, Podocarpaceae, Cupressaceae and Pinaceae. Overall, conifers are distributed in the northern hemisphere, however, the second and the third largest families; Podocarpaceae with 174 species and Cupressaceae with 135 species respectively, extend their distribution to the southern hemisphere, reaching New Zeeland, Madagascar, part of Africa and South America, comprising in this last continent, one of the most Mediterranean conifers species from the Podocarpaceae family, *Prumnopitys andina*, and one of the oldest living trees (3500-4000 years) from the Cupressaceae family, *Fitzroya cupressoides*.

However, these two species have a very restricted area of distribution in the South American continent, limiting its specifically in Chile (90%) and part of Argentina (10%). Human commercial activities such as timber exploitation n and changing land-use have dramatically degraded their habitats and reduced population sizes. Beside the slow growth and natural poor regeneration capacity, make this species intensely vulnerable along the time.

Knowledge gaps in their basic biology represent a big limitation in the development of effective conservation strategies. This is a clear demanding challenge given wide threats to plant biodiversity in the region (harvesting, climate change, pathogens, expanding plantation forestry and agriculture, and natural and human-induced fires).

Though, my PhD project is looking forward to understanding the ecology of four South American conifers, on this occasion, this report will only cover the information that concern to the expedition done in February 2018, which was focused on understanding the regeneration status of *P. andina* and collect DNA material in order to evaluate the genetic connectivity between populations. of *F. cupressoides.*

Area of study and data recorder and some preliminaries results.

The expedition was made in Chile from the Maule to Lagos Region (35º-43ºS). *P. andina*, has a distribution mainly in the Andes mountain from 35º to 39º latitude South, however, the species also has a single location on the eastern slopes of the coastal range in La Araucanía Region and another location in the Central depression, in Malleco (38º 20'S). *Fitzroya* has a distribution from 39º 50'S to 43º30'S in Chile and from 40º57'S to 42º45'S in Argentina. However, for this species specifically, the expedition was only focused in the southernmost population of *F. cupressoides* in Chile, with distribution in the 43º latitude South. The images below show the species distribution where the expedition was focused.

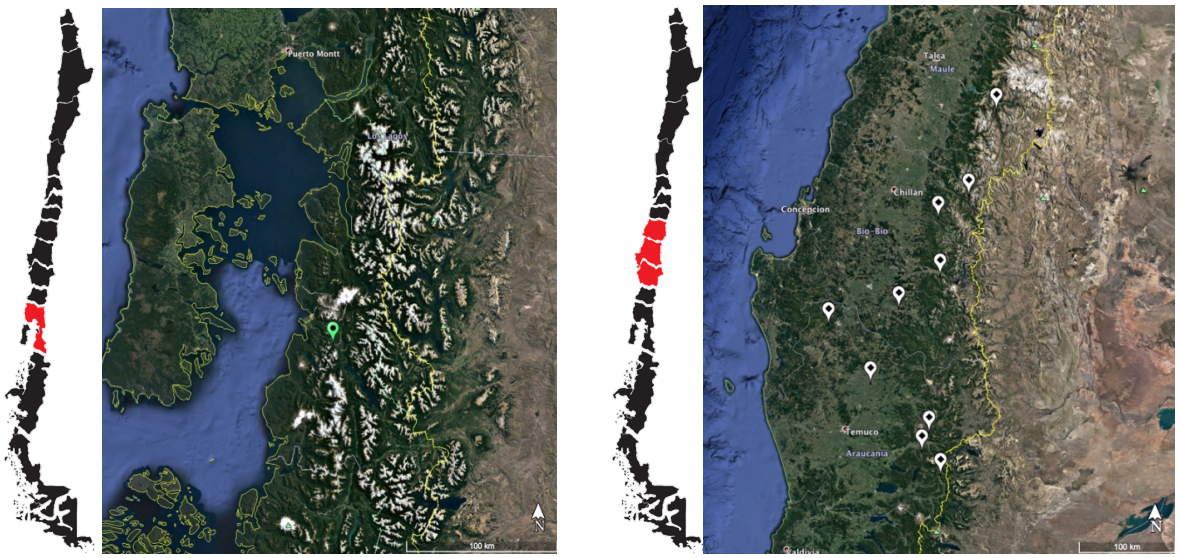

Figure 1. display the locations of F. cupressoides and P andina where the expedition was done. On the left side, the green spot indicates the Southernmost population of F. cupressoides. On the right side, the white spots show the P. andina populations.

Quantification of regeneration: nine populations where sampled representing the entire range distribution of the species in the Andes and Central depression in Chile. The only existing coastal population of *P. andina* in Chile was also under observations, however, due to the small size of the population, trees extremely scattered along the valley and the challenging biogeographical condition of the area, no empirical data were recorded.

The general information recorded from each population include; elevation, slope percent, an estimation of the number of mature *P. andina* trees and a general stand description including the two-dominant species in each plot. A species list at each population was also made using Braun-Blanquet´s Cover Abundance Scale: + (trace); 1 (1-5%); 2 (2-25%); 3 (25-50%); 4 (50-75%); 5 (75-100%). The species list was focused only on trees, shrubs, herbs and climbing plants, excluding another kind of life form due to its natural low presence on the Chilean coniferous forests

Table 1. Populations included in this study, indicating its locations of *P. andina* by population. The populations are listed from the northern to the southern one.

Nº	Stand name	Location	Coordinates	Elevation(m)
1	Corral de Salas	Andes	35º52`58``S-70º59`22.1``W	1017
2	Los Punquios	Andes	36º32`15.2``S-71º11`47.1``W	963
3	Los Lleuques	Andes	36º51`40.4``S-71º36`16.7``W	957
4	Laja	Andes	37º22`25.7``S-71º33`53.4``W	833
5	Trapa-Trapa	Andes	37º40`12.9``S-72º1`12``W	788
6	Púa	Central depression	38º20`26.6``S-72º19`9.5``W	395
7	Conguillío	Andes	38º49`36.7``S-71º39`44.4``W	579-1002
8	Molulco	Andes	38º56`9.1``S 71º42`36``W	744
9	Reigolil	Andes	39º8`8.3``S 71º28`58.7``W	826
10	Nahuelbuta	Coast	37º49`30``S 72º48`29.3``W	871

Map distribution *P. andina*

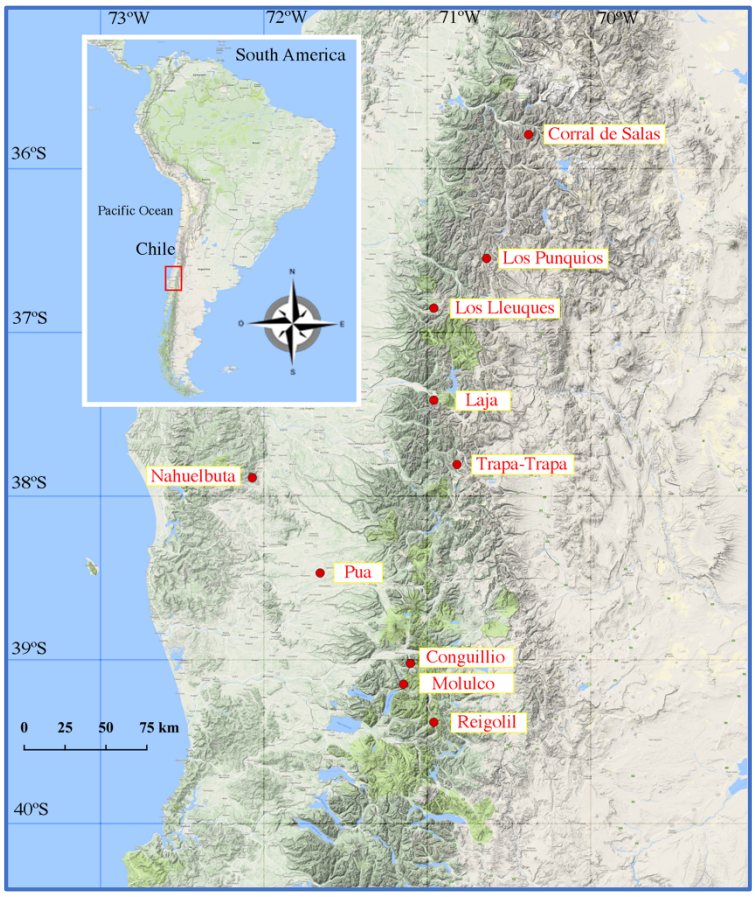

Fig 2. Distribution of *P. andina* populations included in the study. Red dots indicate the location and the population name.

Figure 3. P. andina individual on their natural habitat.

NATURAL REGENERATION OF *P. ANDINA* IN CHILE

Eight populations were sampled using ten plots of 10x10m ($100m^2$) in each population. The northern population (Corral de Salas) was surveyed only with 3 plots of 10x10m due to the small population size and the extreme scattered distribution of *P. andina* in that area, which made difficult to find more than two-three *P. andina* individuals together. The perimeter of each plot was marked with stakes. Each plot was also gridded and marked every two meters with stakes for the purpose of facilitating the orientation in each plot.

In addition, ten subplots of 1x1m ($1m^2$) were systematically made inside of each main plot. Each subplot was gridded with a thin wood frame (1x1m). The regeneration survey was done inside of each subplot, quantifying the number of seedling and sapling of *P. andina*, including other species. The criteria for seedling was <2cm DBH and <1m tall. For sampling was <2cm DBH and >1m tall. Sunlight was also measured following the methodology (Parker and Donoso 1993) and the light intensity estimation following (Wellner, Forest et al. 1979).

Graphic illustration of the plots made to quantify natural regeneration in *P. andina* forest.

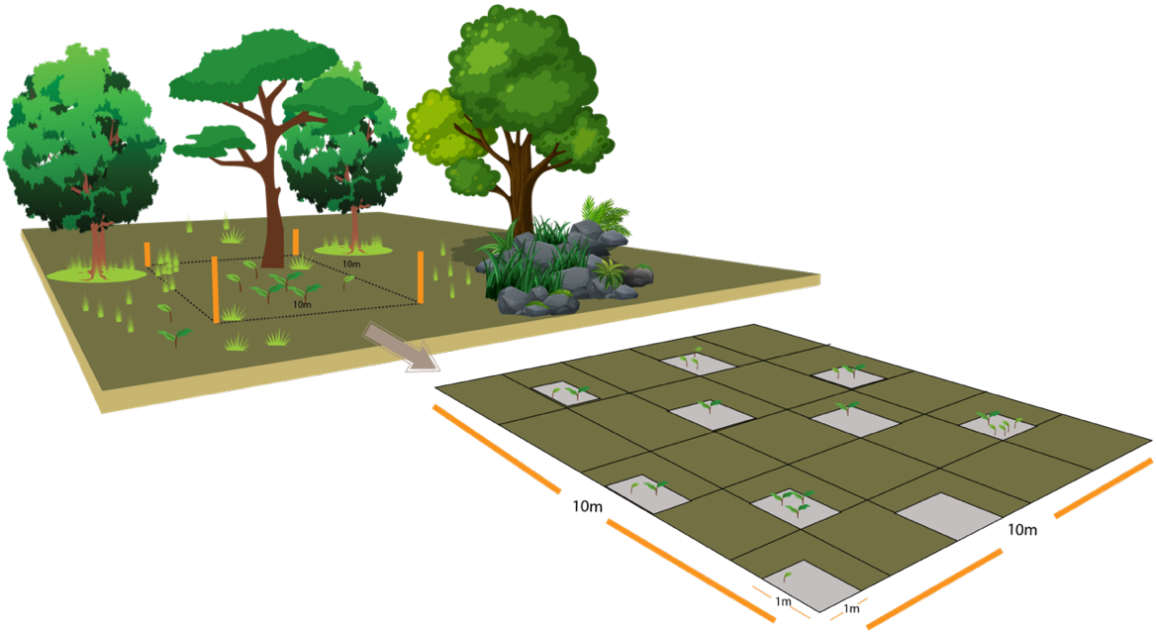

Fig 4. The top image is a representation of the area and plot where the natural regeneration survey was done. The image below represents a projection of a standard plot of 10x10m made to evaluate the natural regeneration of *P. andina*. The ten grey small square of 1x1m in the image below, belong to the subplots where the seedling and sapling quantification was done.

PRELIMINARIES RESULTS OF THE REGENERATION SURVEY

Floristic

A total of 82 plots were done, covering 9 populations. The following information shows the flora associated to the *P. andina* forest.

Table 2. Number and percent of species by life form associated to the *P. andina* forest.

Form	nº species	percent
Trees	23	57.1
Shrubs	13	31
Herbs and Climbing	5	11.9
Total species	42	100

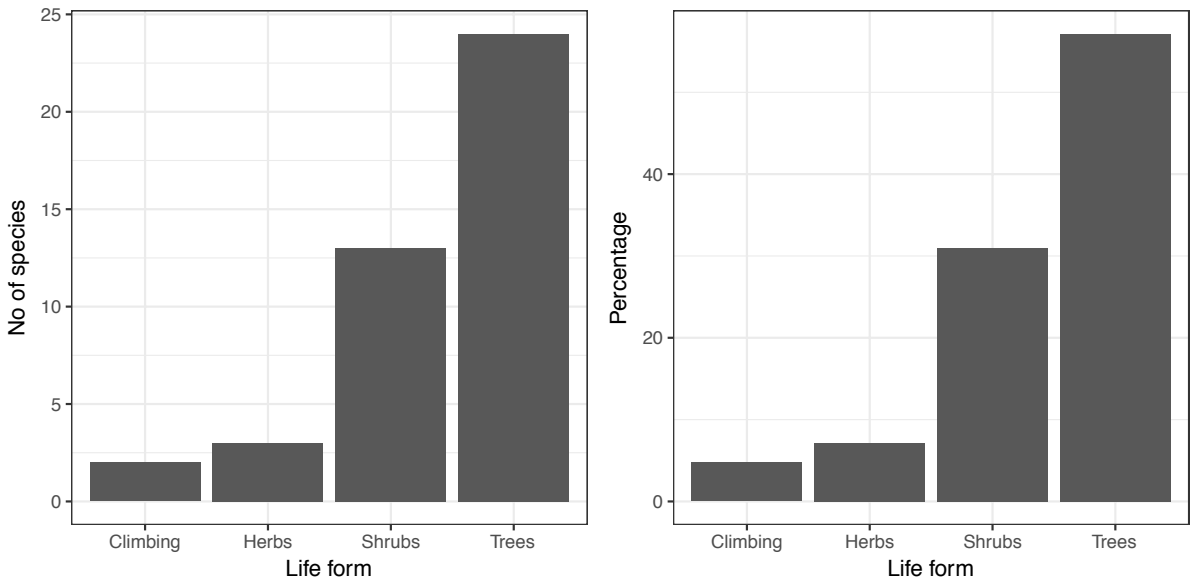

Fig 5. Number and percent of species by life form associated to the *P. andina* forest

Size distribution of the dominant species across population.

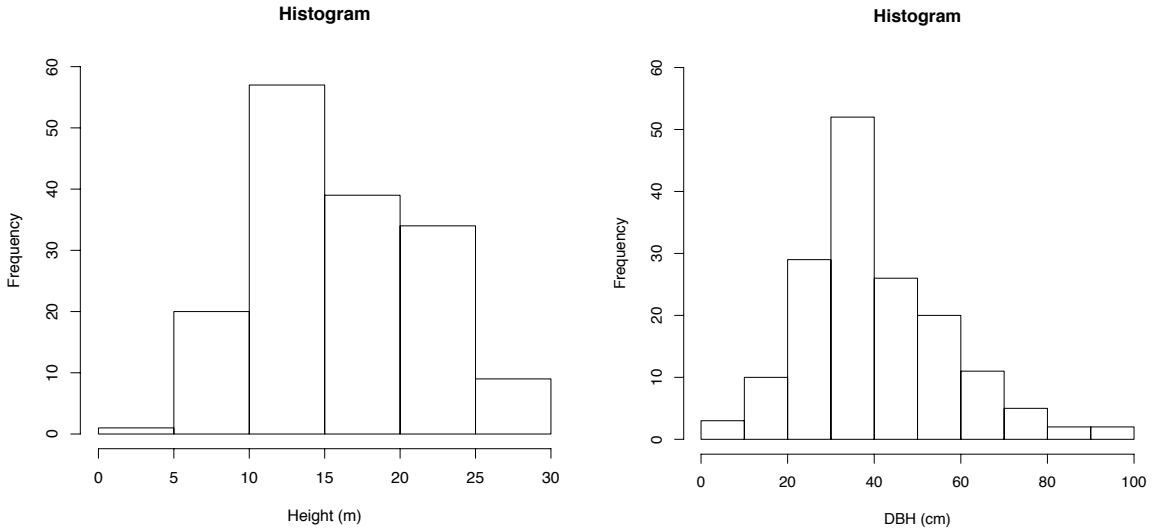

Fig 6. Histogram about the size distribution (Height and DBH) of the dominant species across all populations.

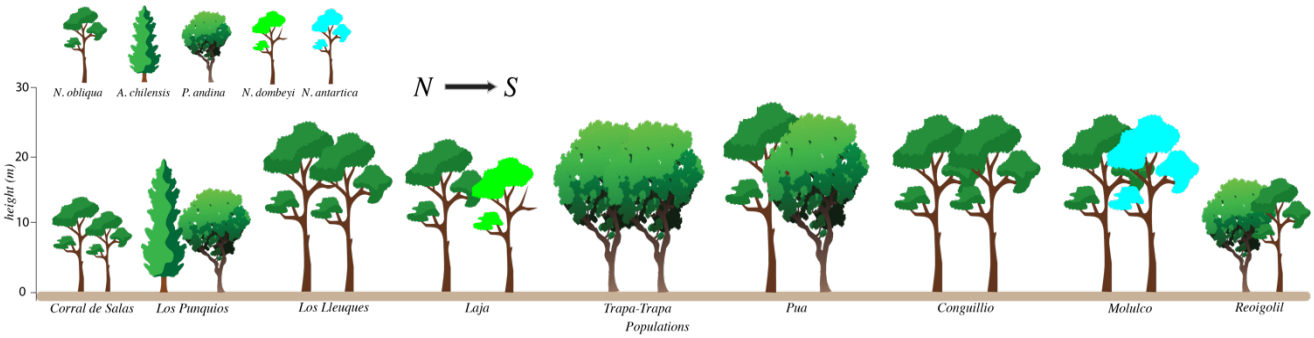

Fig 7. scale drawing of the two highest trees by population listed from the northern to the southern population.

REGENERATION

The following preliminaries results indicate the regeneration status in *P. andina* forests

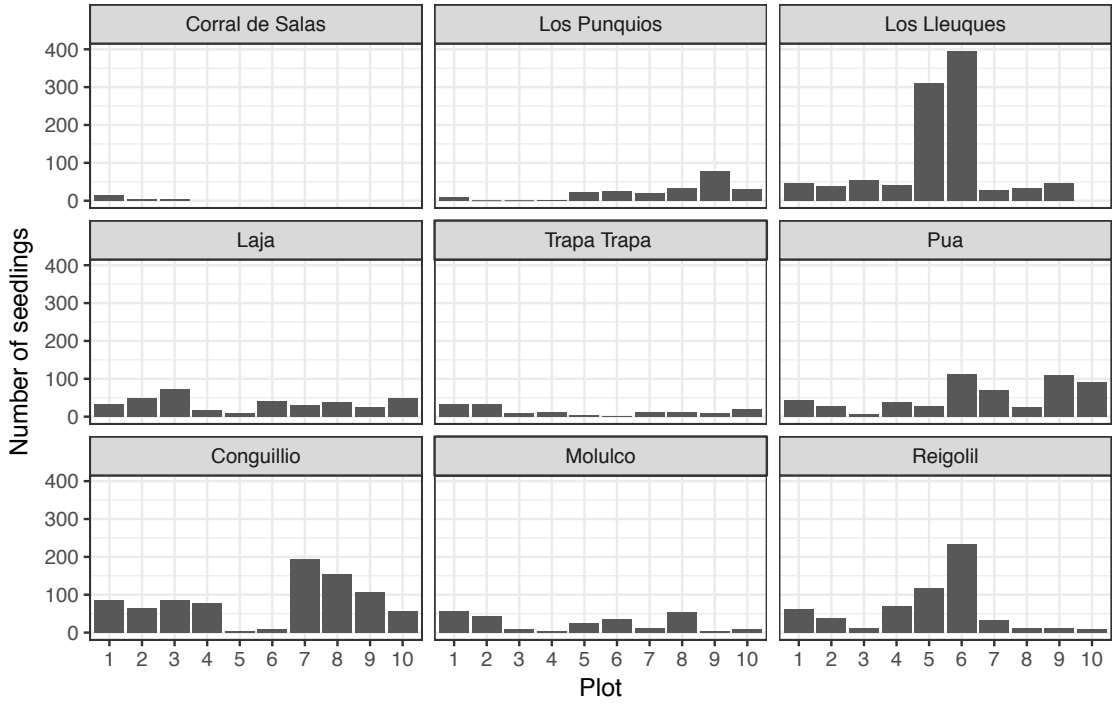

Fig 8. Total number of seedlings (*P. andina* and other species included) by each plot in each population.

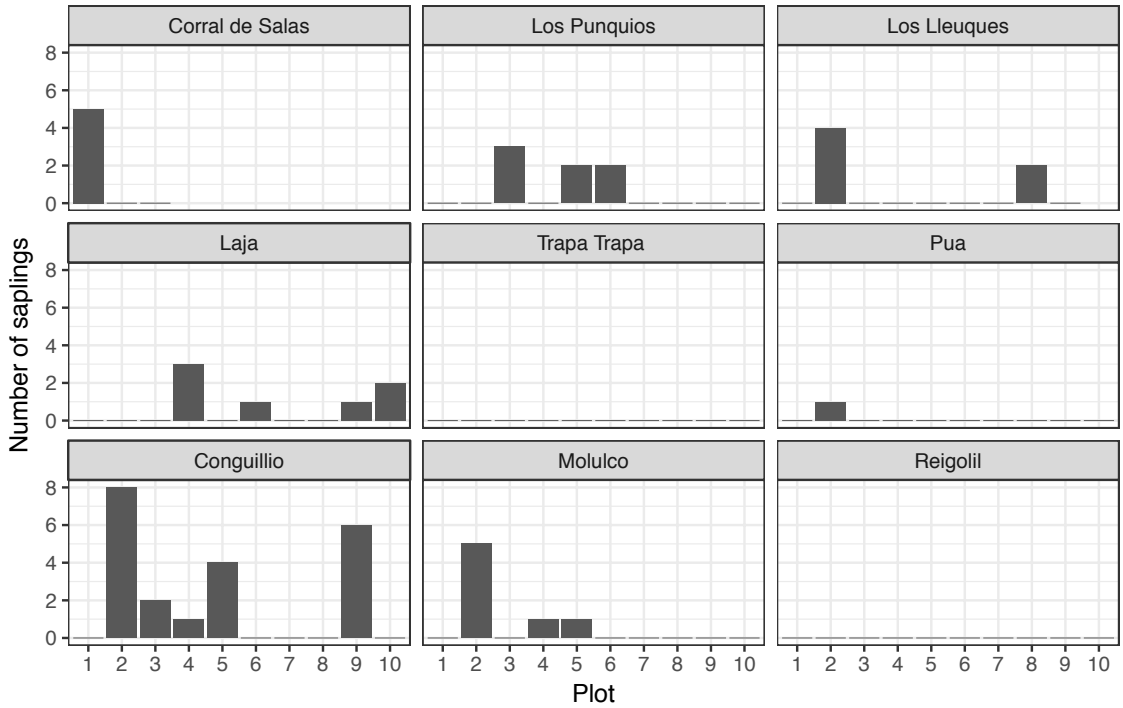

Fig 9. Total number of saplings (*P. andina* and other species included) by each plot in each population.

Table 3. number of seedling and sapling presence of *P. andina* by population, including seedling and sapling of other species. The table also shows the altitude range and the light intensity of each population.

Stand	Location	Elevation range (m)	Light intensity (%)			Regeneration (nº)			
						P. andina		*Other sp*	
			Full sun	Light shade	Extreme shade	seedling	sapling	seedling	sapling
1	Corral de Salas	950-1017	6.7	73.3	20	0	0	27	5
2	Los Punquios	689-977	5	83	12	89	0	130	7
3	Los Lleuques	995-1055	0	86.7	13.3	732	0	255	6
4	Laja	755-832	2	89	9	40	0	327	7
5	Trapa-Trapa	668-728	2	85	13	9	0	136	0
6	Pua	342-377	0	99	1	49	0	501	1
7	Conguillio	579-1002	2	82	16	259	17	578	4
8	Molulco	744-799	1	49	50	154	7	100	0
9	Reigolil	664-832	18	62	20	493	0	106	0

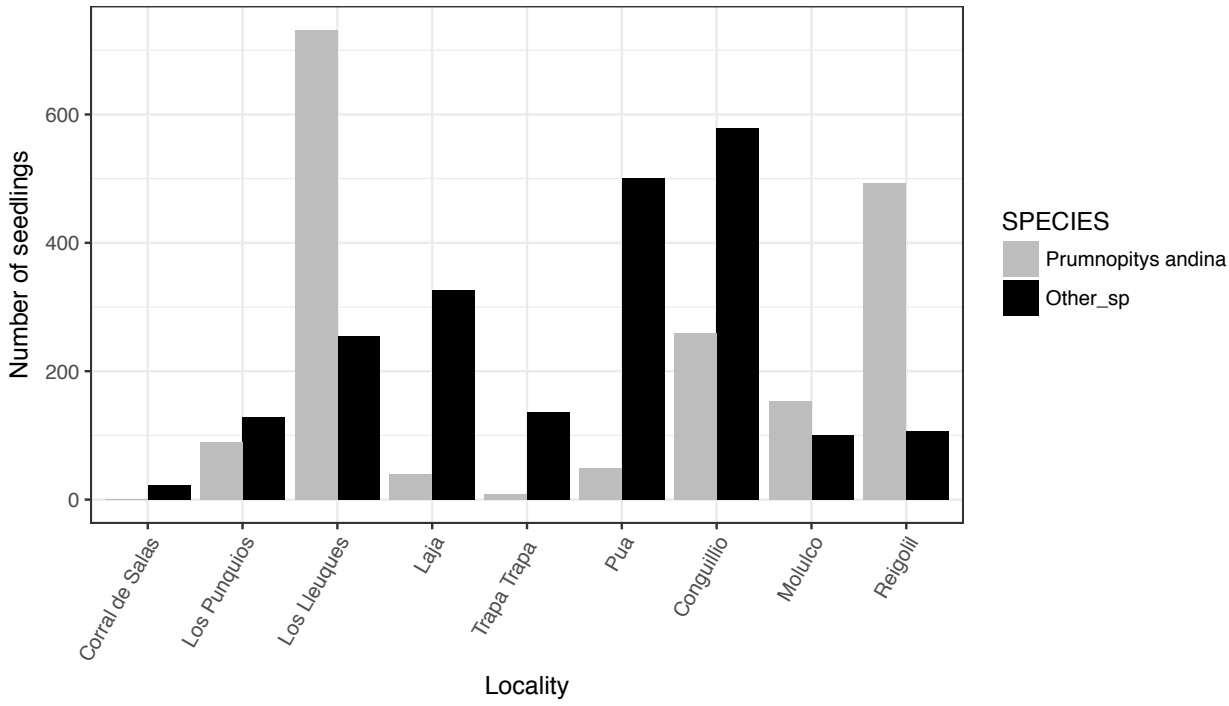

Fig 10. Comparison of the number of seedlings of *P. andina* and other species by population.

Table 4. Percent comparison of *P. andina* regeneration and other species by population.

		P. andina		*Other sp*	
Stand	Location	seedling	sapling	seedling	sapling
1	Corral de Salas	0	0	100	0
2	Los Punquios	40	0	50	100
3	Los Lleuques	74	0	26	100
4	Laja	11	0	89	100
5	Trapa-Trapa	6	0	94	0
6	Pua	9	0	91	100
7	Conguillio	31	81	69	19
8	Molulco	61	100	39	0
9	Reigolil	82	0	18	0

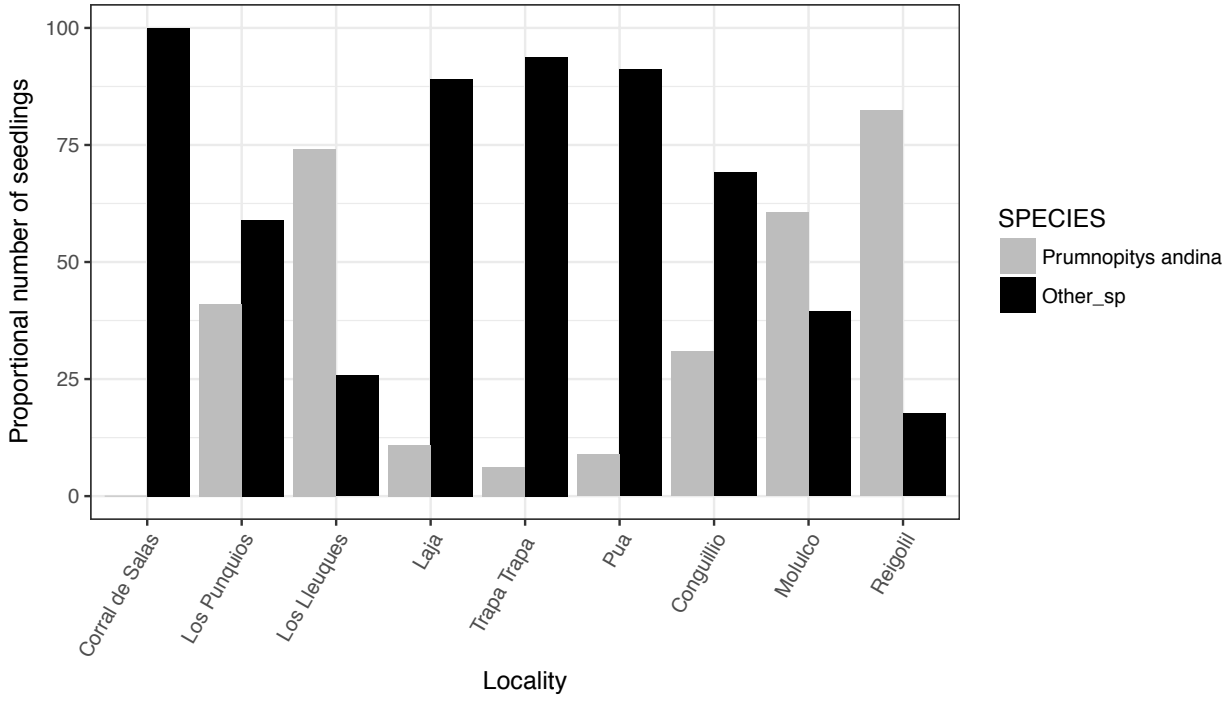

Fig 11. Percent comparison by population of *P. andina* regeneration and other species

Number of DNA samples and populations covered

A total of 25 DNA samples were collected from the southernmost population of *F. cupressoides.* The table below shows the location coordinates where the DNA material was collected.

Table 5. Coordinates of the *F. cupressoides* population covered during the expedition.

Name	Area	City	Coordinate	
Llelcho, Rio Amarillo	Andes	Puerto Montt	43°06'58"S	72°33'15"W

Figure 11. *F. cupressoides individual on their natural habitat.*

No preliminary result done yet.

Itinerary
Chilean Conifer expedition 2018

DATE	ACTIVITY	AREA/POPULATION(S)	COLLECTION
5 February	Arrival to Chile from Edinburgh		
7-9 February	Materials gathering, renting a car, food provision, meeting with assistant, coordination. Travel to Talca		
11 February	Regeneration survey and herbarium collection	Pop 1_Population Corral de Salas	*P. andina*
13 February	Travelling to Chillan		
15 February	Regeneration survey and herbarium collection	Pop 2_Population Los Punquios	*P. andina*
17 February	Travelling to Los Lleuques		
18 February	Regeneration survey and herbarium collection	Pop 3_Population Los Lleuques	*P. andina*
20 February	Travelling to Los Angeles		
22 February	Regeneration survey and herbarium collection	Pop 4_Population Laja	*P. andina*
24 February	Travelling to Quenco		
26 February	Regeneration survey and herbarium collection and travelling to Angol	Pop 5_Population Altos del Bio Bio	*P. andina*
28 February	Regeneration survey and herbarium	Pop 10_Population Nahuelbuta	*P. andina*
1 March	Regeneration survey and herbarium collection and DNA extraction and Travelling to Temuco	Pop 6_Population Pua	*P. andina*
3 March	Regeneration survey and herbarium collection	Pop 6_Population Conguillio	*P. andina*
4 March	Travelling back to Nassampulli		
6 March	Regeneration survey and herbarium collection	Pop 9_Population Nassampulli	*P. andina*
7 March	Regeneration survey and herbarium collection	Pop 8_Population	*P. andina*
8-10 March	Computer work	Valdivia	
11-13 March	Travelling to Chaitén		
12-13 March	DNA collection	Pop_Llelcho	*F. cupressoides*
14-March	Return to Puerto Montt		
15 March	Travelling to Santiago		
19 March	Return to Edinburgh		

Participants

Supervisors.

Prof Pete Hollingsworth

Senior Researcher and Director of Science of the Royal Botanic Garden of Edinburgh

Alex Twyford

Evolutionary biologist from the University of Edinburgh as a NERC Independent Research Fellow

Field assistants.

Ludovica Santilli; MSc in biodiversity and taxonomy of plants from the Edinburgh University and the Royal Botanic Garden of Edinburgh.

Nicolas Lavandero; forestry engineer from the University of Chile, MSc in biodiversity and taxonomy of plants from the Edinburgh University and the Royal Botanic Garden of Edinburgh.

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Reference

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