

*Summer field objectives:*

The objectives for this summer's research were to identify potential study sites for my dissertation and to obtain preliminary data. For my dissertation, I am aiming to understand the challenges of ecological restoration in the Andes, the thresholds where ecological restoration is chosen versus other forms of land use, and to test ecological frameworks in a restoration scenario in Andean landscapes. I obtained local guidance from a Peruvian/Ecuadorian NGO called Consortium for the Sustainable Development of the Andean Ecoregion (CONDESAN), which combines methods in natural, social and GIS sciences in their projects to understand land use change and inform policy. Many of their projects are funded by international agencies such as the United Nations' GEF program, local governments or international development agencies. Collaboration with this institution provided me with logistics to, from and within current restoration sites where they work as well as providing data, equipment and staff for fieldwork. Additionally, by contacting other local NGOs and individuals I was able to visit other restoration sites currently not working with CONDESAN.

*Itinerary and experiences:*

On July 28, 2017, I visited the town of Apuela in the Intag cloud forest in Imbabura, Ecuador. Currently, there have been struggles between community members and mining operations in the nearby mountainsides. Mining projects in this area are locally perceived as "threatening" to the forest and communities. The organization DECOIN (Defensa y Conservación Ecológica de Intag) has worked with surrounding communities to promote the establishment of natural regeneration sites. Areas that have been set aside for assisted natural regeneration have undergone plantings of 12 to 25 native species. Monitoring of these seedlings was done by collaborating international researchers in 2011. However, the question here lies in whether the plantings were successful and whether the communities have engaged in further restoration initiatives since then. In my visit to Apuela, I met with NGO representatives and two community members, which have continued to separate areas for natural regeneration.

On July 31, 2017, I visited La Esperanza in Tungurahua, Ecuador. Restoration in this area has been supported by the Fondo de Páramo and CONDESAN. The goals of restoration of La Esperanza and the NGOs involved are to promote water availability for the region while minimizing soil erosion and degradation from vicuña trampling. La Esperanza is an arid páramo located in the outskirts of the Chimborazo volcano at 4100-4200 m.a.s.l. This area is known as the "arenal" because of the sandy soils of the area. The restoration treatments in the area involve planting native species using a nucleus approach, where one primary species is planted surrounded by nursing or facilitator species. Some of the areas with seedlings were fertilized with vicuña feces, which was also used as protection against desiccation due to high winds in the area. Vicuña trampling is a matter of concern in this area. Because of extreme temperatures, high solar radiation and wind speeds, agriculture has been limited to garlic farming. However, agriculture is subjected to trampling from the vicuñas and diseases passed on from the vicuña hoofs to the garlic plants. Although this is problematic, the Ministry of the Environment of Ecuador does not allow population control of the vicuñas, so many communities have chosen to create exclusion areas. The biophysical effects of the restoration treatments are difficult to assess in this area. Water availability may not increase with the increase in vegetation coverage, but it may prevent further erosion and improve soil quality. This area is important to more than 10 communities in the Tungurahua province in Ecuador that rely on water from the Chimborazo páramo that feeds the Ambato river.

On August 3, 2017, I visited Intillacta, Pichincha in Ecuador. This area is a cloud forest, located northwest of Quito and part of the Andean Chocó region. Land tenure in this area is private with few community owned lands. Historically, the main economic activity in this area has been cattle grazing

with now few families relying on ecotourism, and sustainable coffee and chocolate plantations. Grasses from Africa have been introduced for cattle grazing, but their invasiveness has made them difficult to remove. With the growth of tourism and the idea of forest and biodiversity conservation, more and more families have been attempting to close off an area of their land from grazing and allow it to return to forests. Foresters and biologists have been experimenting to find the most effective and affordable way to eliminate the grasses. For example, some trials involve removing grasses manually or with herbicides and densely planting with native species, or using exotic alders as shade because of the grasses' shade intolerance. An important aspect in this region is that there are two aims in this area for land use: conservation and production. For restoration to be feasible, it must benefit the landowner economically in some way.

On August 8, 2017, I visited the community of Pilpichaca, Peru in the department of Huancavelica. My stay in Peru included visiting three other communities that are involved with bunch grass recovery, including increase of vegetation coverage and feed palatability for alpaca grazing. Local people in this area have historically been alpaca pastoralists and are one of the largest producers of alpaca products in Peru. However, climate change and an increase in alpacas per household have been affecting the grazing quality for the alpacas resulting in lower alpaca weights and reduced quality of their wool. Restoration of the palatable vegetation in this area began in 2011 and 2012 by initiatives funded by the Peruvian government and the Belgian Development Agency. Exclusion fences, aspersions systems and irrigation canals were set up to test the best method to obtain recovery of the soil and vegetation. Five years have shown visually discerning results in grazed and ungrazed areas. Like Intillacta, although the exclusion of areas increases vegetation palatability, it limits present grazing lands, which is potentially detrimental to the economy of local communities.

### *Conclusions and Budget*

Restoration in the high Andes presents several challenges, beginning with the heterogeneity of not only the biophysical factors, such as soil type and amount of radiation but also of socioeconomic factors and land tenure affecting the way land is being used. A pressing aspect of Andean restoration is the changes in climate that are more extreme in mountainous ecosystems, increasing the vulnerability of local populations. The main goal of restoration in all the areas visited in some way or another focused on increasing the adaptability for local people to ensure economic resources by mitigating effects of climate change and environmental degradation. A secondary goal in Andean restoration is to ensure ecosystem functioning and for biodiversity conservation. From this exploration, I have defined two study sites, Intillacta, Pichincha in Ecuador and the three communities in the Huancavelica department in Peru. These two sites will allow me to understand restoration incentives and to compare these incentives internationally. Therefore, accomplishments towards my research involve: a defined focus of my dissertation topic and the study sites to carry it out.

For this fieldwork, I stayed two months in Ecuador and one week in Peru. The Peruvian portion of the trip was funded by CONDESAN; therefore, award funding was used only for the Ecuadorian portion. I was based in Quito for the two months, where I paid for lodging (\$468), round trip ticket to Ecuador was \$540, food per day was \$8 for 60 days (\$480), transportation within Quito was \$50 per month (\$100). Additionally, one visit to Intag, which was not covered by CONDESAN involved transportation, food and lodging (\$100). Field equipment, like write in the rain paper and a voice recorder, was purchased through an additional grant. Trips to La Esperanza, Intillacta and Huancavelica were covered by CONDESAN (including airfare when needed, lodging and food).



**Intag, Imbabura:** Members of DECOIN receiving award for their conservation work in Intag

**La Esperanza, Tungurahua:**  
(bottom left) Water measuring installations.  
(bottom) Members of Fondo de páramo and CONDESAN checking seedlings in restoration exclusion sites.



**La Esperanza, Tungurahua:** (top) Sampling blocks. Low vegetation coverage in this region.



# Intillacta, Pichincha



El Porvenir site-has over 30 years of cattle grazing



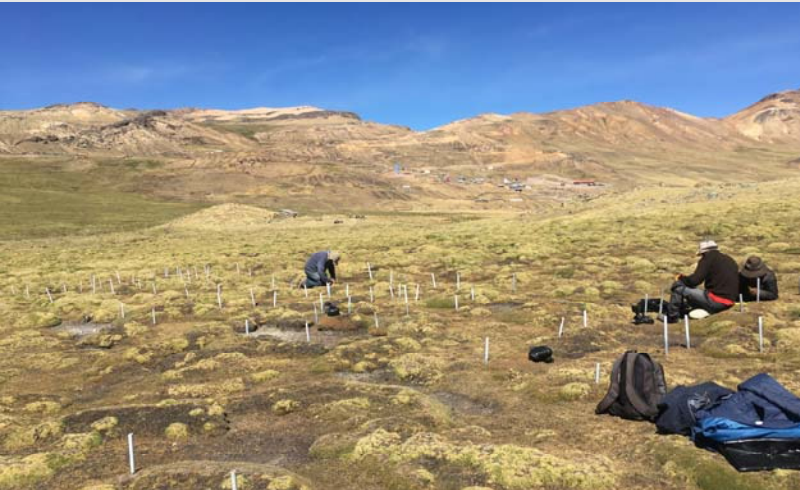
Restoration with alder plantations



Seedlings of native species



# Huancavelica, Peru



(Top left) Area not excluded from alpacas in community of Picchahuasi. Community members and CONDESAN staff collecting biomass samples.



(Bottom left) CONDESAN staff member and me collecting vegetation coverage data in the community of Picchahuasi.

(Top right) Signs at exclusion sites of project in Picchahuasi.



(Left) Pilpichaca community member, University of Huancavelica student CONDESAN staff members and me at the university's field site (Lachocc).





No exclusion sites in Ccarhuancho



Exclusion sites in Ccarhuancho

Huancavelica, Peru

Thank you!

