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# Deforestación y Reforestación:

## Studying and Documenting the Affects of Deforestation and Subsequent Environmental Restoration Efforts in Chilean Patagonia's Chacabuco Valley

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### Abstract

Over the past 100 years in Southern Chile's Patagonia Region, forest cover and natural grasslands were removed to create fenced lands for grazing by sheep and to use the lumber resources, with further harm caused by forest fires other human-related activities (thepatagonianfoundation.org). Controversy now exists in the Chacabuco Valley within Patagonia, where wealthy American Douglas Tompkins, founder of the Patagonia clothing company, purchased private lands from Chilean ranchers in order to restore the natural habitat, where he ordered 400 miles of fencing in the valley removed, erasing the memories of where the ranchers grew up to begin his environmental restoration efforts. With his purchases, he initiated a process to begin creating Patagonia National Park, combining his lands in the Chacabuco Valley with two existing National Reserves. The objective is to alter the impending loss of Coiron grasslands in the valley (to coincide with beech forest reforestation efforts in other areas of Patagonia). According to Conservacion Patagonica, major improvements have been made—with visible advances after just five years—to return natural Coiron grasslands to the region (conservacionpatagonica.org).

This project applies remote sensing methodologies to study the effects and measure the rates of grassland restoration efforts in the Chacabuco Valley from 2004 to present. In order to map this, Landsat-4, -7, and -8 satellite imagery are used to measure changes in the spectral resolutions of the groundcover of the Chacabuco Valley and remainder of the proposed park. The purpose is to monitor the vegetation cover purportedly being replanted in the Chacabuco Valley, in order to assess the accurate success of the efforts by Conservacion Patagonica. After some Chilean ranchers felt alienated by the purchase of their lands and increase in environmental tourism brought by foreign environmental organizations (who are accepting millions of dollars in private funding to reestablish the Chacabuco Valley's beautiful landscape), this project may help discover if visible impacts have been made, and if the purchase of these lands can be properly justified by purported environmental improvements of the region.

### Objective

To discover alterations in the landscape of the proposed Patagonia National Park in Southern Chile, specifically to analyze restoration efforts of Coiron grasses within the park's Chacabuco Valley; to classify the change of landscape based on increased pressure from environmental social movements.

### Methodology

- Developed literature review on foreign group involvement in the environmental improvement of Chile
- Acquired Landsat satellite imagery: first from 1985 (baseline), then 2004 (initiation of restoration), 2007, 2010, 2013, and 2016 (present).
- Early summer imagery is used for continuity and vegetation optimum
- Defined park perimeter for enhanced analysis of the images in the study period
- Performed an unsupervised classification of each image: landscape classified into 8 classes
- Identified particular classes associated with healthy and degraded grasslands—determined from known areas based on photographs and ancillary information

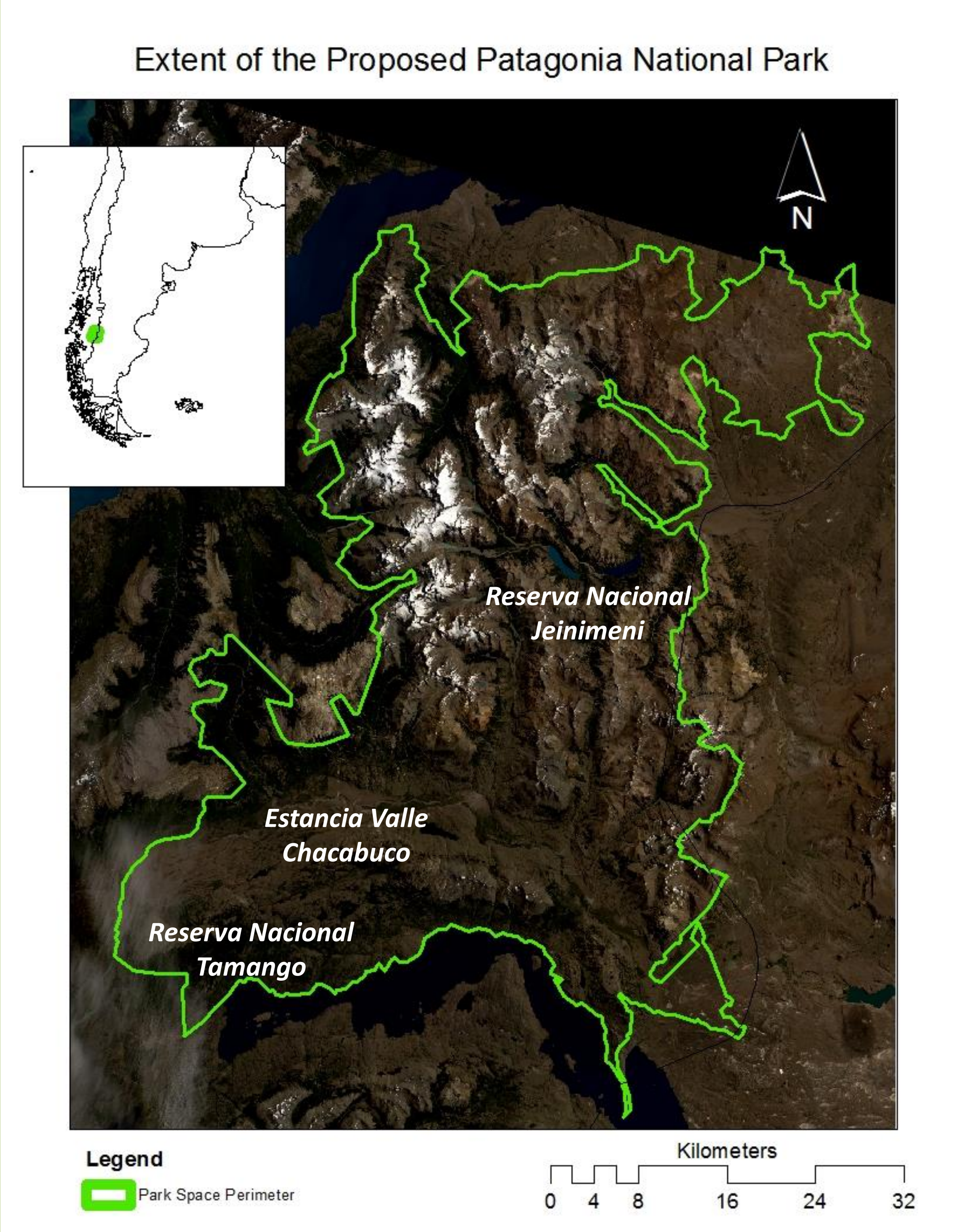


Fig. 1: This map features the two existing National Reserves that surround the Chacabuco Valley, as well as the Chacabuco Valley itself. National Reserves in Chile receive less protection than National Parks do, so it is significant that the National Reserves are included in the creation of Patagonia National Park. The inset map in the upper left corner also details the location of the study area within Southern South America.



Fig. 2: Degraded grassland, looking south from the air strip near the Chilean border post in the east of the Chacabuco Valley. Photograph by Alexandre Rech, 2007.



Fig. 3: Conservacion Patagonica exhibiting the early stages of their planting of young Coiron grasses in the proposed Patagonia National Park. Photograph by Conservacion Patagonica.



Fig. 4: Healthy Coiron grassland featured in a view from the central area of the valley floor. Photograph by Hubert Zumbach, 2012.

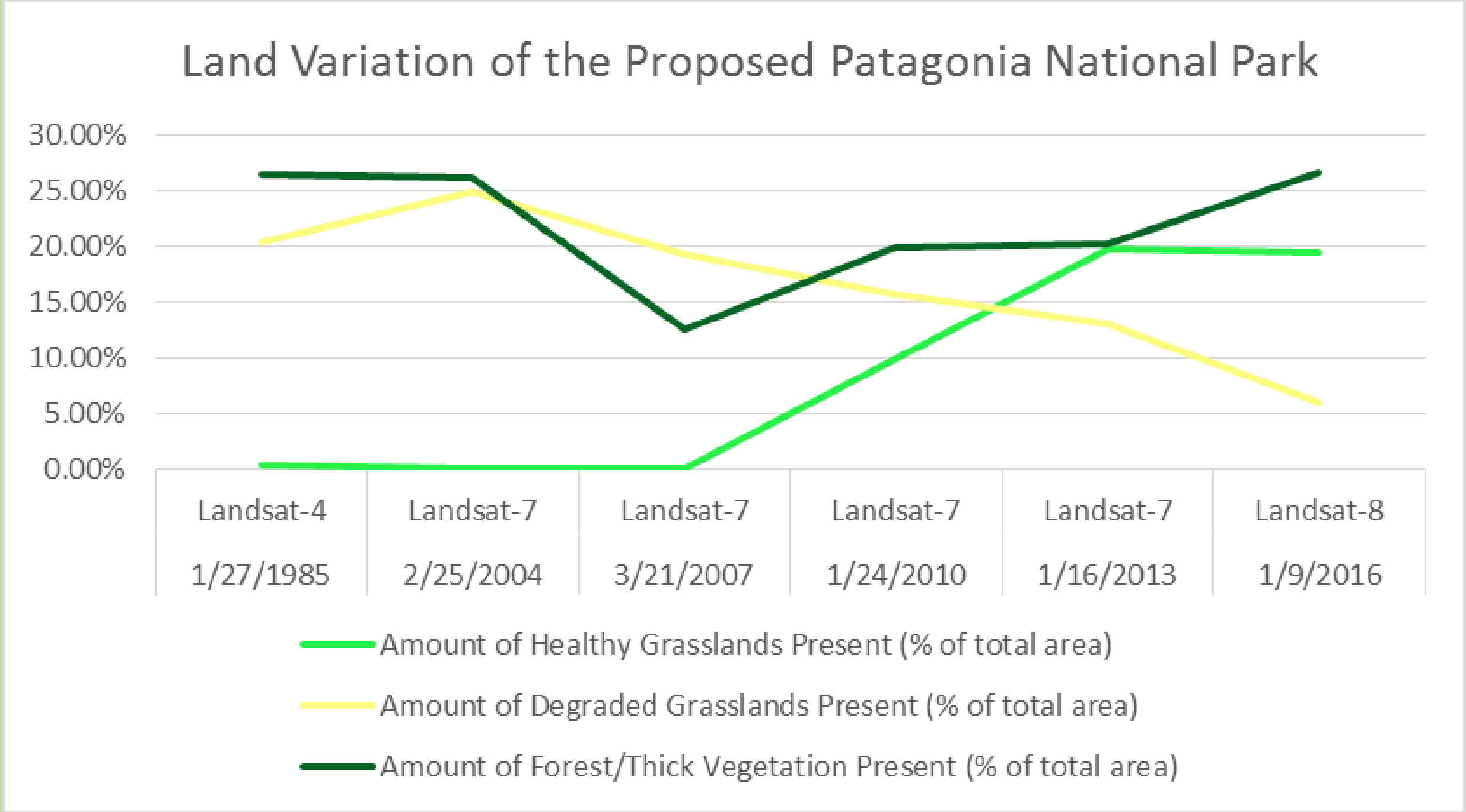


Fig. 5: This graph documents the changes in the study area for 3 of the 8 land cover classifications: Healthy Grasslands (with thriving Coiron grasses present), Degraded Grasslands (largely rocky landscapes that suffered from overgrazing, and Forest/Thick Vegetation (other greenery mostly existing on the lower slopes of mountains). After planting of Coiron grasses began in the Chacabuco Valley in 2004, noted changes occurred, with a rise of Healthy Grasslands beginning in 2010, and a fall in Degraded Grasslands after 2007. Forest/Thick Vegetation likely did not change significantly through this period, because cloud cover existed over portions of the forested areas in 2007, and to a lesser extent in 2010 and 2013.

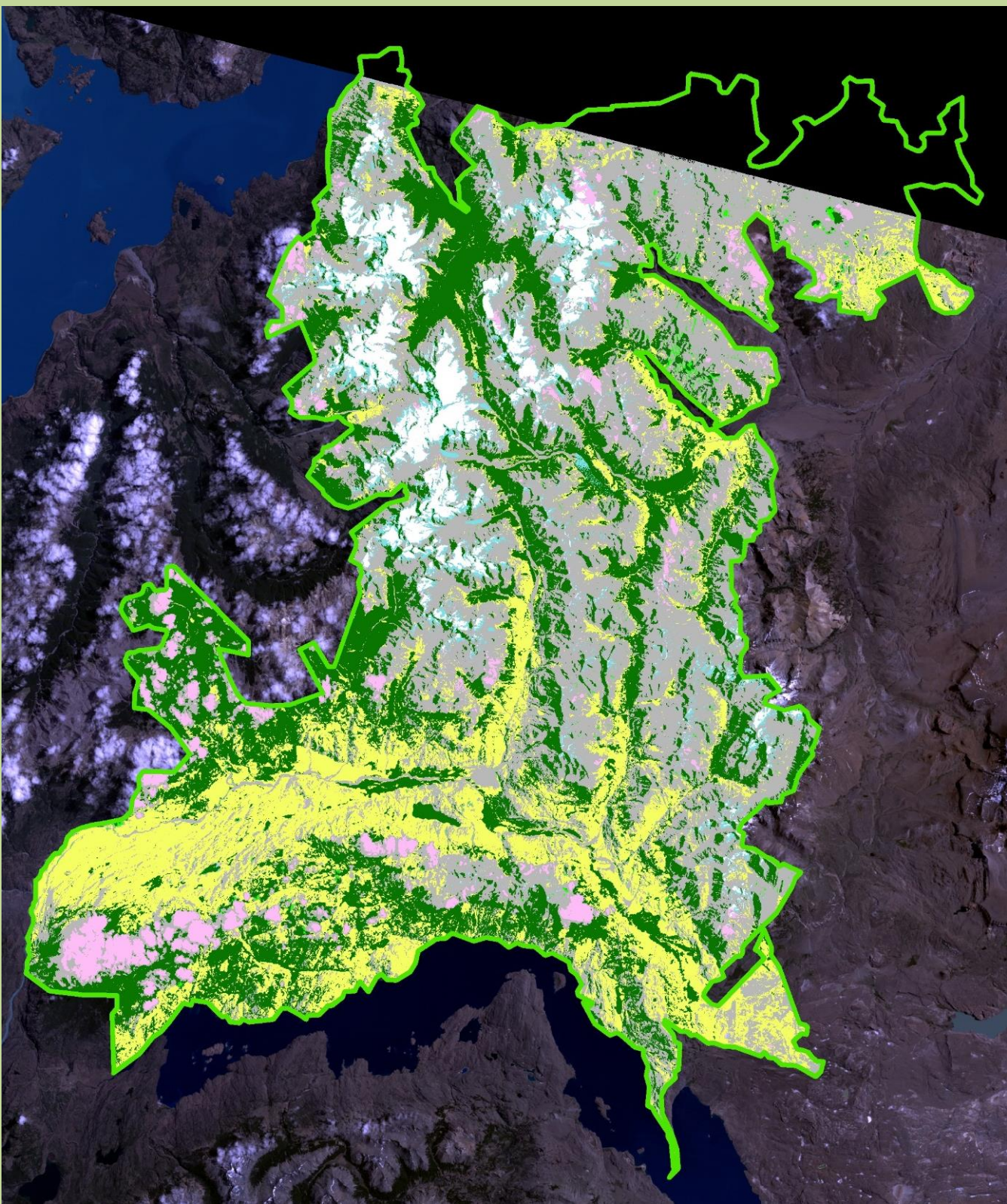


Fig. 6: Landsat-4 image, 27 January 1985. Very small areas of healthy grasslands stood out from the Chacabuco Valley's landscape of largely degraded grasslands. Sheep grazing is very common during this period, harming the natural environment.

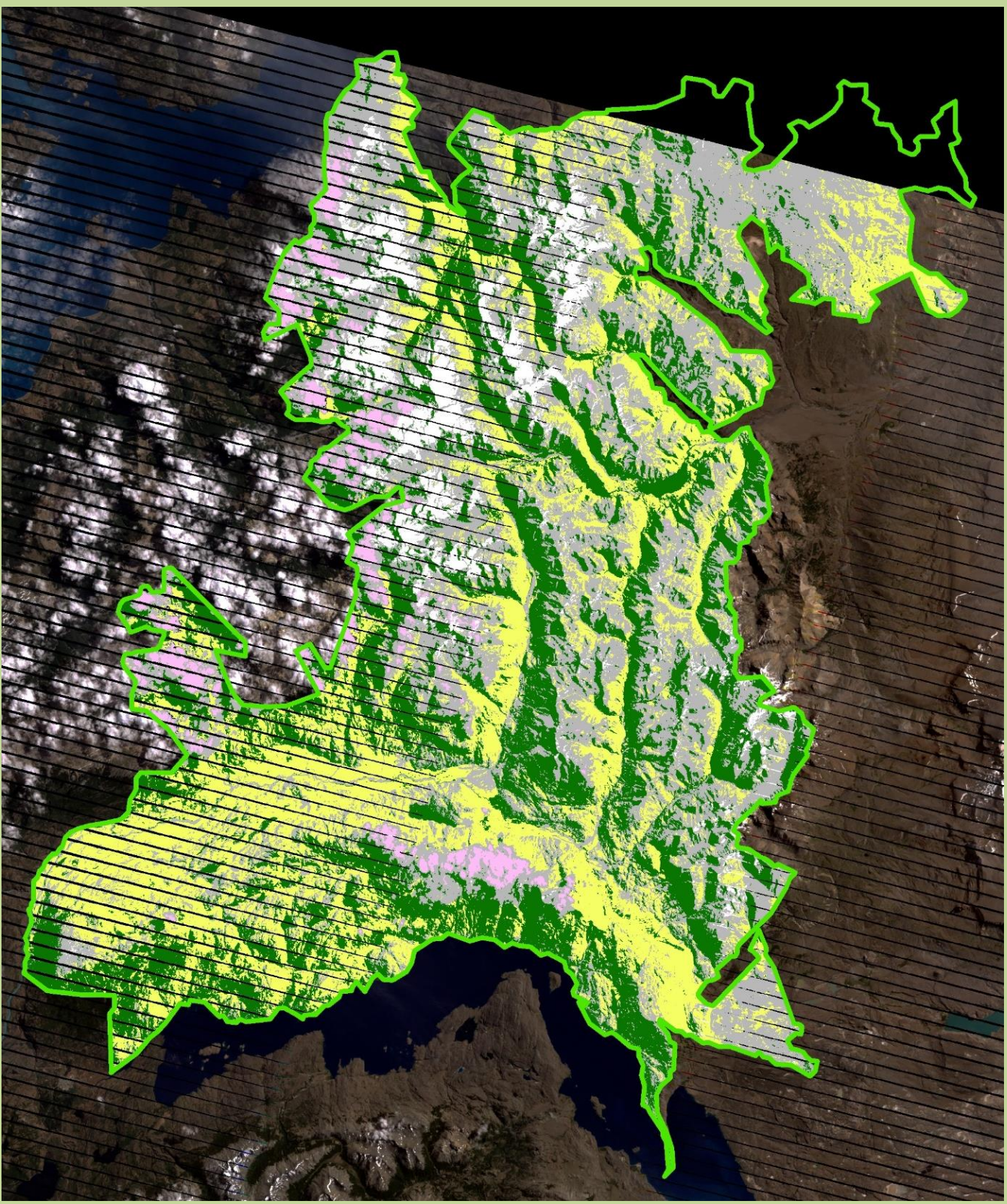


Fig. 7: Landsat-7 image, 25 February 2004. The classifications for this year did not pick up any sign of healthy grasslands, indicating that only small patches remained, but the landscape was dominated by degraded grasslands. Also note Landsat-7's broken Scan Line Corrector (SLC), which had a very small impact on grassland data in relation to the outline of the park boundaries.

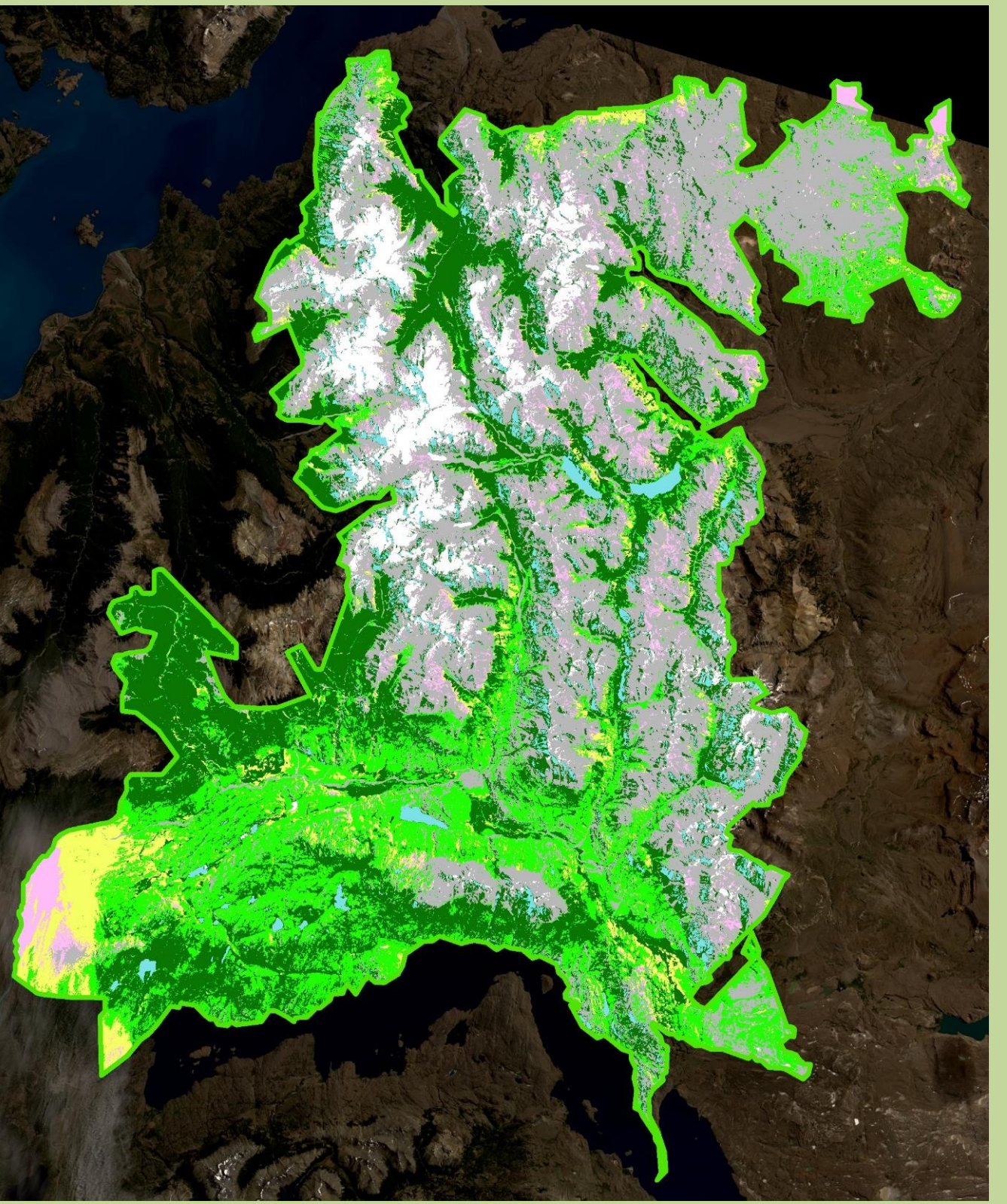


Fig. 8: Landsat-8 image, 9 January 2016. Only small patches of degraded grasslands are present. By this period, most of the 400 miles of fencing had been removed and Coiron grasses were thriving after being planted across the Chacabuco Valley.

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- Select organizations involved in environmental reconstruction in Patagonia:
- Conservacion Patagonica: <http://www.conservacionpatagonica.org>
  - National Forest Corporation, Chile (CONAF): <http://www.conaf.cl/>
  - Parque Patagonia: <http://www.patagoniapark.org/>
  - The Patagonia Foundation: <http://www.thepatagoniafoundation.org/>
  - Reforestemos Patagonia: <https://www.reforestemospatagonia.cl/en/es/proyectos/>

### Results and Conclusions

After an analysis of recent satellite imagery, environmental improvements are visible within the proposed Patagonia National Park's Chacabuco Valley, suggesting that the purchased lands are being restored as claimed to ultimately provide the Chilean citizens (and foreign tourists) a scenic area where the natural landscape is protected.

It can be determined that financial support for the environmental groups operating in the study region of Chile is assisting in the regrowth of the Coiron grasses in the Chacabuco Valley.

This work addresses just one of many questions necessary to consider for full implementation of the park; further work is needed to assess the cultural and societal impacts of foreign intrusion and land ownership on the Chilean ranchers.