

# Restoration ecology, rewilding, pastoralism and food security: renewing old connections in central Chile

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## Rewilding – pastoralism – food security

Restoration of the semi-arid Chilean silvopastoral system called “espinal” is a longstanding challenge [1, 2]. **Proyecto REGenera** proposes a restoration approach inspired by rewilding, or the reintroduction of species to restore functioning.

Pastoral systems are adaptations to environmental heterogeneity and variability, and may involve both domestic and semi-wild species. With sedentarization, the capacity for dynamic responses to the environment is lost, and with factory farming may be decoupled from local variability while strongly coupled to regional or inter-regional fodder production. Extensive pastoral systems have a large water footprint, which has been used as an argument against extensive meat production as a component of food security [3]. However, the water input (precipitation) to pastoral systems produces a large number of supporting, provisioning and cultural ecosystem services, which intensive meat and vegetable production do not.

Indigenous Picunche in central Chile may have had a guanaco-based espinal silvopastoral system, but little is known about it.

Rewilding provides lessons on passive and dynamic approaches to megaherbivores as management tools. We argue that the ecological restoration of a dynamic rewilding-inspired espinal can broadly contribute to food security as well as biodiversity and sustainability.



Espinal silvopastoral system, central Chile.



Guanacos (*Lama guanicoe*) at the research site. They both browse and graze.



Regrowth of espino branch eaten by a guanaco 4 months earlier.



Higher herb biomass under espino canopies. Whether this is due to canopy shade alone or also to hydraulic uplift is unknown.

## Ecological basis for Proyecto REGenera (Restoration of Espinal with Guanacos)

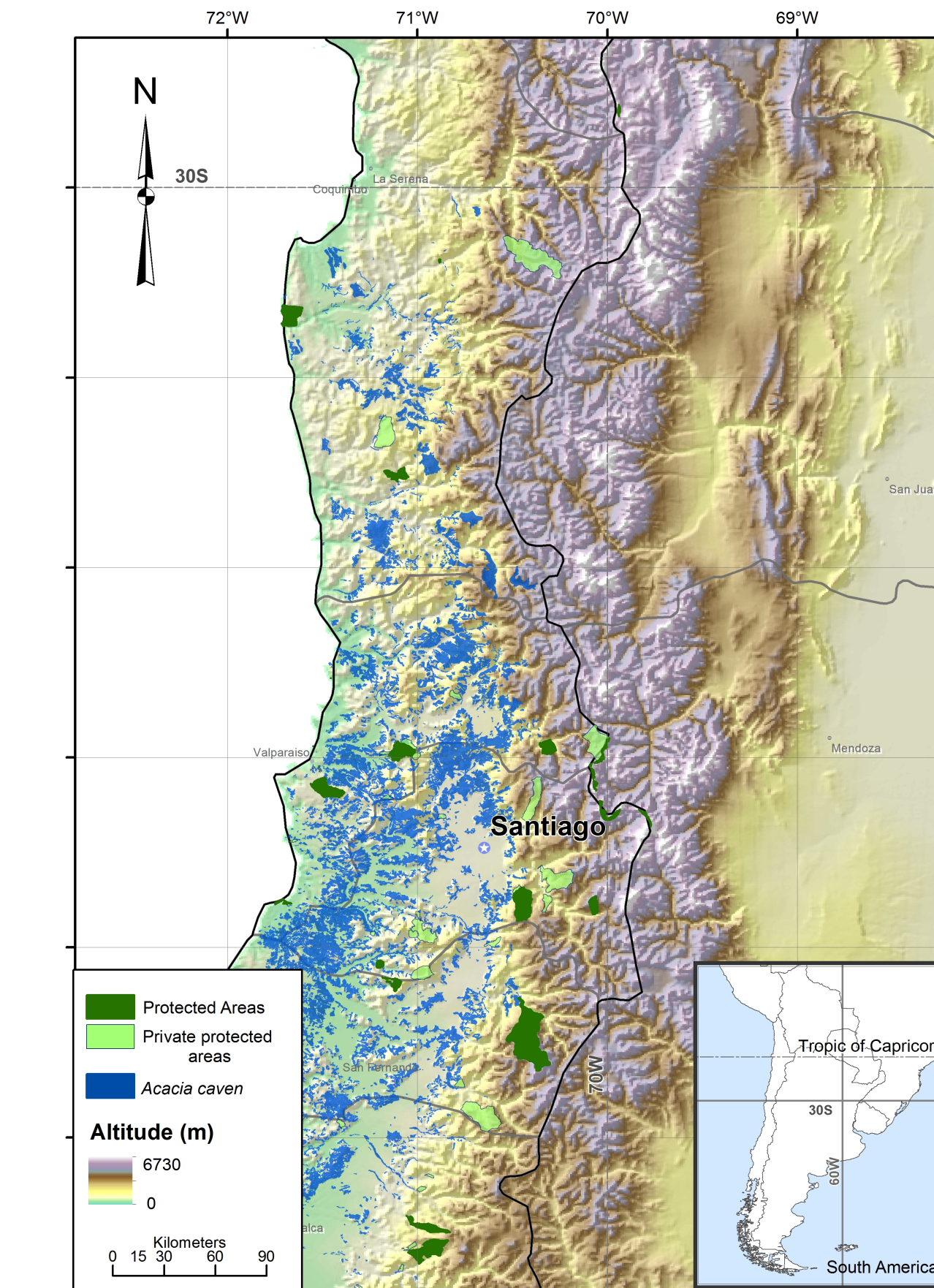
*Acacia caven* (“espino”, forming espinal savannas) shows compensatory growth when pruned. This is a useful management tool because maximizing canopy shade in this semi-arid habitat improves herbaceous biomass production and livestock welfare, and may have positive biodiversity impacts. We hypothesize that compensatory growth is an adaptation to past herbivory by a missing megaherbivore. We hypothesize that this is the guanaco (*Lama guanicoe*), which is no longer found within the distribution of *Acacia caven* in central Chile due to colonial hunting.

We reintroduced 5 guanacos into a 1 ha espinal to study their foraging behaviours and the growth response of the *Acacia caven*. The research is ongoing.



Ecosystem services (unep.org) expected in espinals post-restoration with guanacos.

Service	Impact mechanism	Ref
Provisioning: Food	Increased canopy shade leads to higher forage biomass, lower water need, lower offspring mortality of livestock.	Olivares 2006a, b
Provisioning: Fuelwood	Harvesting for firewood and charcoal is unsustainable but seems to have declined due to other fuel availability.	
Provisioning: Fiber	Guanaco wool is a luxury product under CITES certification.	
Provisioning: Biochemicals	Tannins and other chemicals can be extracted from bark.	Suescun et al. 2012
Regulating: Climate	Increased tree cover.	
Regulating: Water	More water stays in the soil with higher canopy cover.	Olivares 2006a, b
Cultural: Recreational	Bird watching, guanaco observation, rural tourism	
Cultural: Aesthetic	Guanacos add aesthetic value to espinal landscapes.	Lindon & Root-Bernstein accepted
Cultural: Inspirational	Promoting local sustainable community-based solutions.	
Cultural: Educational	Environmental education, community-based adaptive management	Lindon & Root-Bernstein accepted
Cultural: Sense of place	Guanacos increase valuation of espinal on intrinsic and aesthetic grounds	Lindon & Root-Bernstein accepted
Cultural: Heritage	Pre-columbian heritage of human-camelid interactions	
Supporting: Soil formation	Tree cover prevents degradation.	
Supporting: Nutrient cycling	<i>Acacia caven</i> is a leguminous N-fixer	
Supporting: Primary production	Restoration will increase <i>Acacia caven</i> and herb biomass.	



Distribution of espinals in central Chile. Lack of conservation and conversion to intensive agriculture has led to fragmentation.

## Expected results and proposals

- A brief pulse of guanaco browsing should stimulate annual espino growth
- Develop a regional transhumance system to bring guanacos to espinal patches needing restoration and management
- More efficient production of free-range livestock.

[1] Ovalle et al. 1999. Arid Soil Research and Rehabilitation 13, 369-381.  
[2] Root-Bernstein & Jaksic. 2013. Restoration Ecology 21(4), 409-414.  
[3] Mekonnen & Hoekstra 2012. Ecosystems 15, 401-415.