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Building alliances and consensus around social-ecological rewilding in Chile

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We provide a case study of how we position our rewilding project in central Chile in order to find scientific and social support and build alliances, collaborations, and consensus. Our core vision focuses on reintroducing guanacos (*Lama guanicoe*) to central Chile in order to provide natural restoration and ecosystem processes in *espinal* woodlands dominated by the native tree *Vachellia [Acacia] caven*. We envision a scenario of "social-ecological rewilding" with widespread guanaco browsing in woodlands and guanaco migration across the region, coexisting with multiple human uses of the landscape. Guanacos would ideally be managed by regional collectives who could benefit from guanaco tourism, sustainable harvest of their fiber (wool), and regulated hunting. Our wider vision for reintroductions and integrated conservation management extends to a set of other species that may have coexisted with guanacos and *V. caven* at various points in the past, but more research is necessary to establish and gain support for evidence-based baselines. Our strategy is to inspire actors with greater resources (land, money, influence) to share our vision and implement it, in collaboration with the NGO that we have formed to support our projects. Over ten years, circulating alternate interpretations and a novel imaginary of how central Chile was in the past and could be in the future, along with developing and testing scientific hypotheses, has moved our vision from an idea shared by two people to one that a wide variety of actors publicly embrace.

KEYWORDS

guanaco (*Lama guanicoe*), rewilding, Chile, *Vachellia caven*, social-ecological system

Introduction

Rewilding is a conservation movement that has multiple origins (e.g. Soulé and Noss, 1998), some of which crystalized as frustrations with traditional conservation and its focus on short-term population and species targets (Jepson, 2022). It is expanding and becoming a legitimate option for management within some parts of Europe (Carver et al., 2021; Segar

et al., 2022), although it is not immune from social conflicts (Wynne-Jones et al., 2018; Pellis, 2019). There are emerging projects and opportunities around the world, including in South America (Root-Bernstein et al., 2017a). As we understand rewilding, it conducts species reintroductions for restoration, that is, targeting keystone and ecosystem engineering species in order to restore missing ecosystem functions and processes. This functionalist aim leaves room to consider the use of proxy taxa with similar ecological functions to extinct species (Griffiths et al., 2010). In addition, we think of rewilding as favoring a redistribution of agency, autonomy and regulation from humans back towards other species, commonly referred to as "passive management". There can thus be different degrees of rewilding (Pedersen et al., 2020). This, in turn, implies accepting the possibility of changing, unknown, and non-analogue ecological states and trajectories (Williams and Jackson, 2007). We support a coexistence position, in which restoration of ecosystem processes and passive management are compatible with human interactions with nature (Carver et al., 2021; Guerrero-Gatica et al., 2023).

In this paper we describe our vision for rewilding in central Chile, a project which we envisioned beginning ten years ago in 2014. We describe our strategies for building alliances and consensus around the project, and how this allows us to overcome barriers such as lack of data, capacity, funding, control over land, or political influence. Some questions for further research, to which we do not yet have answers, can be found in Appendix 1 (Supplementary Material).

Context

Central Chile, understood as including the administrative regions from Maule to Coquimbo, is a mediterranean-climate region of significant plant endemicity and global conservation priority (Myers et al., 2000; Scherson et al., 2014). Its main habitat types are espinal early-successional open woodland, matorral shrubland and sclerophyllous forest, forming mosaics according to hillslope aspect, disturbance history, and other factors. These habitats are linked by succession (Root-Bernstein et al., 2017b). Espinal is used as a silvopastoral woodland, and is dominated by *Vachellia [Acacia] caven*. The majority of woodlands and forests in central Chile are spontaneously recovering from historical clearing for charcoal production or agriculture (Schulz et al., 2010; Vergara et al., 2013; Root-Bernstein et al., 2017b). Chile is characterized by a terrestrial mammal fauna dominated by species < 100 g, likely due to biogeographic isolation and Pleistocene-Holocene megafaunal extinctions (Mella et al., 2002; Hernández-Mazariegos et al., 2023). Extant camelids and deer are extirpated from most of central Chile, although these have been ecologically replaced to some degree by free-range cattle, horses, and sheep. A greater richness of medium and large animals was present in central Chile prior to the megafaunal extinctions in the late Pleistocene/early Holocene, followed by a wave of extirpations after Spanish colonization (Root-Bernstein et al. in submission; Carrasco, 2002).

Central Chile has long been regarded as degraded, in ways that are intertwined with the history of land reform, rural development and a neoliberal economic approach (Armesto et al., 2010; Solimano, 2009; Root-Bernstein, 2014). It is undervalued as "Nature", densely populated, and extensively converted to industrial agriculture (Romero et al., 2003; Schulz et al., 2010; Root-Bernstein, 2014). In 2002 less than 2% of the central zone was under state protection (Pauchard and Villarroel, 2002) and in 2011 94% of central zone vegetation types had less than 10% of their area under state protection (Pliscoff and Fuentes-Castillo, 2011). In 2022, the situation had improved with 3.99% of the central zone (Coquimbo-Maule) under state protection (calculation based on Pliscoff, 2022) and only one vegetation type lacking any kind of protection ("thorny mediterranean forest of *V. caven* and *Lithraea caustica*") (Pliscoff, 2022). According to Petit et al. (2018), only two public protected areas in central Chile have effective management plans. This protected area gap is partly compensated for by private protected areas (Schutz, 2018; Pliscoff, 2022), but these lack strong legal protections (Root-Bernstein et al., 2013). Apart from the translocation of injured or problem animals, there has to our knowledge only been a very small number of translocation or reintroduction projects in Chile, focusing on huemul (*Hippocamelus bisculsus*) and guanacos (Vidal et al., 2018), some of which are not publically documented. Restoration work focuses on the elimination of invasive species and tree planting (Medina-Vogel et al., 2015; León-Lobos et al., 2020). To the best of our knowledge, there is only one other initiative that identifies itself as rewilding in Chile: the reintroduction of Darwin's rhea (*Rhea pennata*) in Pumalín Douglas Tompkins National Park and Patagonia National Park, until 2019 a Nature Sanctuary owned by Pumalín Foundation. This project is carried out by the foundation Rewilding Chile, until 2021 known as Tompkins Conservation Chile, which along with the Pumalín Foundation is the Chilean branch of the Conservation Land Trust based in California and funded by the businessman Douglas Tompkins.

Ownership of non-agricultural land in Chile is dominated by private landholdings called *fundos*. These are the remnants of the latifundia system put in place by the Spanish colonists, in which colonial landowners benefited from the labor of peasants, many of whom were essentially serfs (*inquilinos*) often kept in debt to the landowner and paid in kind rather than in money. Other mestizo peasants roamed central Chile as itinerant jack-of-all trade workers (*gañanes*). The social order changed with the Land Reform that took place in the period between 1962-1973, in which many *fundos* were expropriated by the state and transferred to peasant collectives (Wright, 1982; Kurtz, 2001; Murray, 2003). This process was arrested and to a large extent reversed following the coup in 1973, and many landholdings were sold to third parties who then invested in industrial agriculture, including pine and eucalyptus plantations, vineyards and fruit orchards (Kurtz, 2001; Murray, 2002). Since then, industrial agriculture for export has been the focus of investment in rural development. On the positive side many former *inquilinos* and other peasants ended up as smallholders owning or renting their land, with diversified

livelihoods animated by a variety of non-monetary values (Root-Bernstein, 2020; Root-Bernstein et al., 2020). However, these values are viewed as antithetical to rural development, and a transition to micro-enterprises and market-oriented production is favored by PRODESAL, the government office supporting smallholders (for a comparable situation in the south of Chile, Di Giminiani, 2018). This stance is shared by environmentalists, who see cattle raising and other traditional management and resource-use practices as antithetical to conservation— the elimination of peasant livelihoods was described as a policy of CONAF, the government Forestry department, as part of their strategy to meet Convention on Biological Diversity and climate change targets (pers. comm. C. Ravanal to MR-B 2019). A widespread discourse directed at *ganaderos* and *arrieros*, two traditional livelihoods focused around non-intensive cattle and horse raising, urges them to give up their way of life and invest their money in ways that will allow them to aspire to the middle class (compare Mayol Miranda et al., 2013).

Although central Chile does not have rural practices recognizably rooted in an indigenous background and is not a legally recognized indigenous area, it is a region with strong mestizo peasant traditions and identity. In rural areas and small towns, many people mix wage labor, for example working for national and local government administration or for the mining industry, with diversified smallerholder subsistence farming (Root-Bernstein et al., 2020; Guerrero-Gatica et al., 2023). Traditional cattle raising in espinal, and later-successional woodlands still occurs but is increasingly under pressure as *fundo* landowners reneg on traditional rights of access. Although there is a positive trend in the increase of private landholders setting aside their land for conservation (Schutz, 2018), it is concerning to us that the majority consider appropriately pro-environmental management to be anti-cattle and anti-resource use, in the absence of any local empirical studies to back up this conclusion. In central Chile, cattle are typically kept not for market-oriented production, at low densities with little human contact, practically in the same way as rewilded cattle in Europe, as a traditional practice with symbolic cultural importance. Other traditional timber and non-timber forest resources include charcoal production from *Vachellia [Acacia] caven*, production of *tierra de hoja* (a kind of natural compost) from leaf raking (leaf litter collection) in woodlands dominated by *Peumus boldus* and *Lithraea caustica*, collection of the bark of *Quillaja saponaria* for soap production, collection of *Peumus boldus* leaves and other medicinal herbs such as *Haplopappus* spp. for herbal tea, and collection of the mini coconuts of the endemic Chilean palm *Jubaea chilensis* (Caucheteux unpublished data; see also Moyano Altamirano, 2014). Small-scale honey production in sclerophyllous forest has been introduced as a successful export product. The ecological impacts of all of these activities (except honey production) are assumed to be negative but have not been studied. We hypothesize that, in the absence of any large native browsers or soil disturbers, the reduction of cattle and horse grazing by exclusion, and the reduction via regulation of leaf raking, may together contribute to increasing the intensity of wild fires, which is a serious and increasing problem in central Chile (Urrutia-Jalabert et al., 2018; compare Mathews and Malfatti, 2024).

History of the project

The origin of our vision of social-ecological rewilding in central Chile was learning that the espino *Vachellia [Acacia] caven* in silvopastoral espinal woodlands can be managed by pruning and coppicing, in order to produce compensatory growth, and a cascade of benefits (A. Olivares pers. comm. 2013; Olivares, 2016). We hypothesized that the extant animal most likely to be a potential co-evolutionary partner and browser of trees is the guanaco (*Lama guanicoe*), as we explain in the next section (*Justification*). The first phase of the project (2014-2016) was a naturalistic experiment with five guanacos, to understand if they do browse *V. caven* and how this tree responds (Root-Bernstein et al., 2016; Root-Bernstein et al., 2024a). The result was that guanacos spontaneously browse *V. caven*, which shows compensatory growth, as predicted.

The second phase of the project (2017) was the release of the experimental guanacos in the private Cascada de las Ánimas Nature Sanctuary (Guerrero-Gatica and Root-Bernstein, 2019; Figure 1). The result was a gain in knowledge and experience with the regulations and practicalities of native animal translocation, for which there is little institutional experience in Chile. The third and ongoing phase of the project (2019-present) is the creation of a guanaco rehabilitation and breeding center in the same nature sanctuary. The fourth phase, for which our partners are currently seeking funding, was envisioned in 2021 when we were contacted by Sara Larraín, an environmental philosopher and political activist with her own environmental NGO (Chile Sustentable), to co-develop a project to reintroduce guanacos into the San Francisco de Lagunillas y Quillayal Nature Sanctuary (Figure 1). Subsequently the proposal evolved into a much larger project that intends to create a corridor of private landholdings and public protected areas in the Andes to the east of the capital, Santiago. Sara Larraín, in collaboration with the guanaco expert Benito González, has developed a plan that will incorporate both passive repopulation of guanacos from Argentina across the corridor and our planned active release program in Cascada de las Ánimas (phase three).

Three events were also important in bringing together a community of collaborators and supporters. The first was a symposium on guanaco rewilding that we organized with the Center for Applied Ecology and Sustainability, Pontificia Universidad Católica de Chile, in 2019, to which we invited a large number of Chilean guanaco experts and NGOs, including WCS Chile. This led to a second important event, which was the invitation to take part in a working group led by WCS Chile on guanaco conservation in central Chile. The report from the working group was presented at an event in May 2024 (Silva et al., 2024). This event brought together an even broader set of associations and interested parties. Actors who support our work and share our broad vision include several private landowners, certain private protected areas, some public protected area officials, other environmental NGOs active in Chile, academic researchers, individuals from the arts and traditional crafts sectors, in addition to students, volunteers and other members of the public who engage with our NGO through our outreach activities. The third

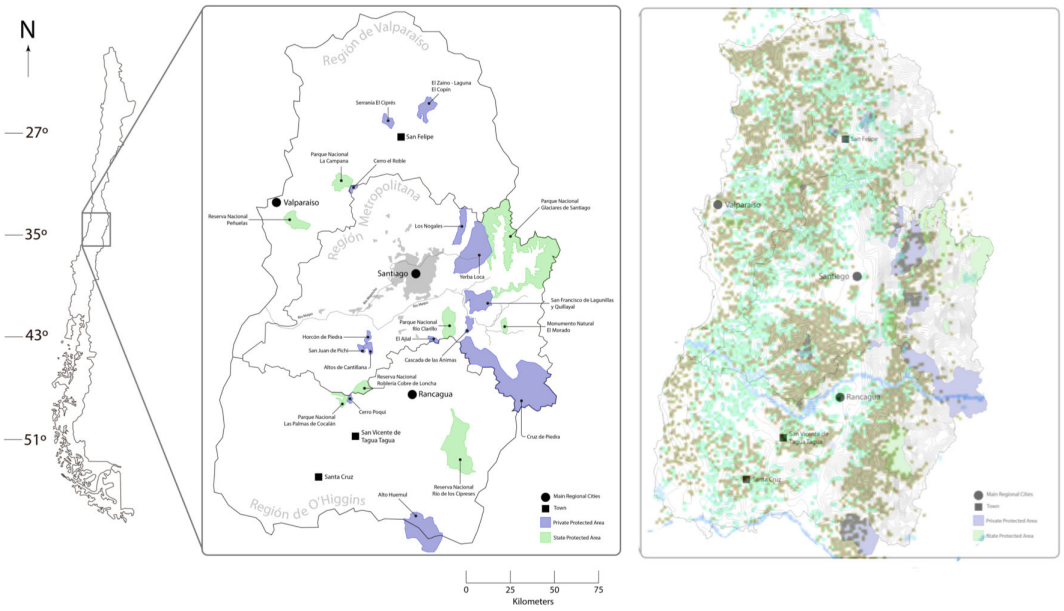

FIGURE 1
Map showing public and private protected areas in three regions of central Chile. This includes areas where we currently work, and areas where hope to work in the future. Inclusion on this map does not indicate current collaboration with our project. In the map on the left, in purple, private protected areas and nature sanctuaries; in green, public reserves and national parks; in light gray, the urban area of Santiago. On the right, grey lines indicate altitude isoclines, light green dots indicate espinal habitat and olive green dots indicate sclerophyllous forest. Land cover is adapted from Root-Bernstein and Svenning (2017) as allowed by the license.

important event was that, in 2023 and after 3 years of effort, we formed ourselves as a legal NGO, Kintu.

Justification of the project

Ecological restoration justification

We see rewilding as contributing to a restoration of central Chile, although rewilding and restoration are different concepts (Corlett, 2016; Derham, 2019; du Toit and Pettorelli, 2019). Our initial hypothesis, that guanacos are the browsing species to which *V. caven* compensatory growth is an adaptation, draws on a corpus of work on the ecological and silvopastoral benefits of coppicing and pruning espino (Benedetti, 2012; Olivares, 2016). This work shows that coppicing and pruning results in compensatory growth and increase in the tree canopy area, which can lead to a positive cascade of effects increasing ecological and agricultural productivity (Olivares, 2016). This corpus of work was thus the justification for our initial experimental phase of the project. Browsing large herbivores have been absent from almost the entire range of *V. caven* in central Chile for around 500 years, so there was no scientific knowledge on this interaction. Our results show a nuanced outcome (Root-Bernstein et al., 2024a). The resulting net compensatory growth was relatively small. The implications for how best to use guanacos as a restoration tool remain to be developed. Our resulting hypotheses are that *V. caven* may be adapted to more intense or damaging browsing than what is provided by guanacos, and that this may have been historically provided by the large number of megaherbivores present in the range of espino through the early Holocene (Root-Bernstein et al., 2024a). We also noticed that guanacos have potential non-trophic ecological impacts such as facilitation of plant growth around dung middens (Guerrero-Gatica and Root-Bernstein, 2019). We are currently carrying out experimental research to document these impacts and to assess whether they are beneficial or harmful to the ecosystem on balance.

Historical baseline justification

The historical pre-Columbian ranges of both guanacos and *V. caven* are well-established (e.g. IUCN), making them native to Chile and with overlapping historical ranges. Initially we took this as sufficient justification to study the potential ecological impacts of reintroducing guanacos into central Chilean habitats with *V. caven*. Historical baselines in restoration are, today, often understood as providing data to inform the management of future non-identical ecosystems (Gillson and Marchant, 2014; Beller et al., 2020). In line with this position, we are actively researching the development of historical baselines that can inform the management of future ecosystems in central Chile (Root-Bernstein et al. in submission). These baselines may or may not support our current vision, but we will adjust our vision in an evidence-based manner. Additionally, stakeholders sometimes raise questions about nativeness and naturalness of these species and their interaction. Proving that guanacos and *V. caven* are native to Chile (e.g. with earliest dates of presence in the Chilean parts of their ranges compared to dates of speciation) and that the interaction is natural (i.e. the two species have a significant coevolutionary history) raises a number of evidentiary challenges. We discuss how we deal with this issue below.

Guanaco population conservation baseline

One of the criteria for a successful reintroduction project can be the stabilization of a viable population (Robert et al., 2015). It was not our original goal to reintroduce guanacos in order to contribute to creating a viable population. Guanacos are not globally considered endangered (Baldi et al., 2016) although they are considered vulnerable in central Chile, due to their historical extirpation (especies.mma.gob.cl, visited 18/7/2024). Currently, guanaco population dynamics specialists are pursuing a strategy of allowing passive repopulation of areas from which guanacos have been historically extirpated (pers. comm. B. González 2024). Our proposal that guanacos could be actively reintroduced on the basis of other justifications described here, puts us in apparent conflict with this position (although stage four of our project envisions both active and passive reintroduction). We discuss below how we engage with this potential conflict.

Cultural values justification

Some scholars claim that values emerge from collective experiences of emotion and transcendence (Durkheim, 1912; Dewey, 1939; Joas, 2023). Other theorizations argue that value emerges from symbolic exchanges and transformations (Mauss, 1950; Appadurai, 1988; Graeber, 2001). The French tradition of environmental ethics provides another perspective (Larrère, 2006). Once established within a culture, values are mobilized in multiple contexts and according to multiple evaluative frames and registers, which are subject to conflict and negotiation (Maris et al., 2016; Heinich, 2017). Conservationists expect a set of environmental values to motivate pro-environmental actions (Chan et al., 2016; Tadaki et al., 2017; Chan, 2020; IPBES, 2022). Because rewilding may ultimately have socially transformative impacts (IUCN Rewilding Thematic Group, 2018), the emergence of new collective values could be a result of the project. In the first instance, however, we focus on understanding how existing values are mobilized to justify and motivate actions in the central Chilean context.

Research we carried out before this project started pointed to the low public valuation of and tenuous attachments to central Chilean landscapes (Root-Bernstein, 2014), related to their perception as being underdeveloped, degraded and associated with poverty (Beau, 2017). We identified central Chilean species that were widely recognized, although not universally loved—including *V. caven* (Root-Bernstein and Armesto, 2013). Before phase one of the project was implemented, we carried out a questionnaire-based study to assess the values that Chileans would refer to, to support or oppose a hypothetical guanaco reintroduction project in central Chile (Lindon and Root-Bernstein, 2015). When we presented the guanaco as native to the region (which many people are not aware of), support for the hypothetical project was high. The values referred to included the intrinsic value of nature and our moral obligations to protect it, the increased aesthetic value of seeing guanacos in central Chilean landscapes, the value of the guanaco as a cultural symbol of South American or Chilean wilderness, and potential economic benefits (Lindon and Root-Bernstein, 2015). We found comparable results when we repeated the study in the rural community where the third phase of the project is underway (Guerrero-Gatica et al., 2023). This aspect of the research is not complete, and the project requires a constant dialogue around cultural values, justifications and acceptability with potentially affected populations, through a co-construction approach (Guerrero-Gatica et al., 2023).

Economic benefits justification

As we found in our original study on public support for guanaco reintroduction in central Chile (Lindon and Root-Bernstein, 2015), economic benefits may garner support for the project. The neoliberal pro-entrepreneurship context also supports developing this justification (Kurtz, 2001; Murray, 2002; Di Giminiani, 2018). Guanaco observation, as a form of nature tourism, is one proposition that could attract investment and also be a source of income for rural people who already have relevant knowledge and skills (Guerrero-Gatica et al., 2023; pers. comm. Adrián Tapia 2024). Guanaco fiber, sheared sustainably and with high animal welfare (Carmanchahi et al., 2022), is currently commercialized as luxury textiles in Peru and Argentina. Perhaps this industry could also be established in Chile.

Vision and hopes for the future of the project

Our rewilding vision can be expressed in the form of several propositions that orient our scientific research and applied work. These propositions are similar to hypotheses but are not stated with scientific rigor; rather multiple scientific hypothesis can be derived from them. They are also not goals, although goals can also be derived from them. By propositions we mean assertions, with supporting arguments, about the true or the possible:

- *Reintroducing guanacos to espinal will restore beneficial ecological cascades.*
- *Guanacos belong in central Chilean woodland mosaics.*
- *The espino* Vachellia [Acacia] caven *is a beneficial native tree that should be protected in central Chile.*
- *Involvement of local communities is essential.*
- *Multi-species rewilding can be scaled up across all of central Chile.*

Reintroducing guanacos to espinal will restore beneficial ecological cascades

Our results (Root-Bernstein et al., 2024a) suggest that guanacos can play a role in stimulating the established beneficial ecological cascades increasing productivity as a result of compensatory growth in espinal (Olivares, 2016). We speculate, but have at this point no experimental evidence for central Chile, that guanacos could

contribute to ecosystem functions and processes such as fire control (by eating the herbaceous layer; Rouet-Leduc et al., 2021), soil nutrient cycling (via dung middens; Veldhuis et al., 2018), shade and soil moisture provision (through their impacts on *V. caven* canopies; Olivares, 2016), and landscape level connectivity (seed and nutrient dispersal during seasonal migration; Bauer and Hoye, 2014). It is important to note that our vision is flexible and can adapt to evidence as it is produced. For example, our experiment in phase one suggested that guanaco browsing, even at high densities, has a smaller positive effect than optimized coppicing and/or pruning (Root-Bernstein et al., 2024a). This turned our attention to other (extinct) species to which espino compensatory growth may be adapted, thus expanding our vision to other rare, missing or potentially missing species (see below).

Guanacos belong in central Chilean woodland mosaics

The guanaco is strongly associated with Patagonia and Tierra del Fuego, where it is abundant, and is a Chilean symbol of wilderness (Lindon and Root-Bernstein, 2015). However, as noted above, guanacos are recognized as previously having a native range across the entire Southern Cone of South America (Gonzalez et al., 2006). Guanacos are generalist grazers and browsers that live in a wide range of habitats. Guanacos are currently found in semi-arid wooded habitats including open woodlands of Argentina, and the Chaco in Bolivia (Gonzalez et al., 2006; Cuéllar Soto et al., 2017). Researchers of remnant guanaco populations in the Argentinian Chaco consider that guanacos lived there both before and during at least 3000 years of human occupation (Costa and Barri, 2018). However, guanacos living in wooded areas is regarded by some researchers in Chile as unnatural, an outcome of avoiding anthropogenic pressure (e.g. Puig et al., 1997; Cavieres and Fajardo, 2005; Muñoz and Simonetti, 2013).

It is difficult to obtain evidence of paleoecological or historical species interactions between a tree and a large herbivore. Microwear evidence from fossil guanaco teeth would reveal whether guanacos in central Chile were mixed grazers and browsers as they are across their range (e.g. Rivals et al., 2013), but such evidence would not indicate precisely which species was being browsed. Like other acacia pollens, *Vachellia (Acacia) caven* pollen does not register in lake sediments. A positive functional adaptive interaction would also not in itself be evidence of co-evolution (Root-Bernstein et al., 2024a). Historical records that we are aware of do not describe precisely what guanacos in central Chile ate. We thus do not expect to ever have definitive proof that guanacos browsed on *V. caven* in central Chile at specific times in the past. From a scientific perspective, we are content with a functionalist rather than a compositionalist justification for their reintroduction (Gillson et al., 2011).

In addition, government policy is that guanacos from Patagonia and Tierra del Fuego, where the population is abundant and subject to lethal control to reduce its numbers, cannot be released in central Chile (pers. comm. Servicio Agrícola y Ganadera 2017, pers. comm. Servicio Agrícola y Ganadero, 2023). Particularly, the Servicio Agrícola y Ganadero cited the "genetic issue" as an important barrier to reintroducing guanacos from Tierra del Fuego, which at the same time is the only place where the state allows removal of guanaco individuals, due to the good status of the population (pers. comm. Servicio Agrícola y Ganadero, 2023). The "genetic issue" is related to whether it is safe to interbreed different guanaco populations. Genetic studies have shown that the Patagonian and Tierra del Fuego populations are all descended from northern populations in the last several thousand years (Hernández et al., 2019) although recent habitat fragmentation is leading to differentiation between the populations (Sarno et al., 2015; León et al., 2024). León et al. (2024) claim that there are two subspecies of guanacos, one in Peru and one in the rest of South America, in contrast to earlier papers that found inadequate differentiation to substantiate the existence of any subspecies (Gonzalez et al., 2006; Marín et al., 2008). León et al. (2024) also express the opinion that reintroductions and translocations of guanacos should be carried out with extreme conservatism, given that they identify a handful of genes for certain enzymes that differ between populations within the southern subspecies. In contrast, Frankham and colleagues recommend assessing the risk of outbreeding depression from crossing distantly related populations and the risk of inbreeding depression from not re-connecting fragmented populations (Frankham et al., 2011).

To obtain legally releasable guanacos in the short term, we have partnered with the Cascada de las Ánimas Nature Sanctuary to develop phase 3 of our project. The center will be able to accept guanacos from the region that are injured and cannot be re-released into the wild. However, we will legally be allowed to release their offspring into the wild because they are from a local population. We hope that the first release of guanacos bred in the rehabilitation center can take place within 5-10 years.

The espino *Vachellia [Acacia] caven* is a beneficial native tree that should be protected in central Chile

The tree *Vachellia [Acacia] caven* (locally called *espino*), the megafloral partner in this project origin story, has an almost opposite public perception to guanacos, as it is associated both in the popular imagination and in scientific research, with poverty, degradation, and poor land management by peasants (Root-Bernstein, 2014). Early ecological research in central Chile proposed a pre-colonial ecological baseline of a primary, closed, continuous sclerophyllous forest (Armesto and Gutierrez, 1978; Solbrig et al., 1977). By the 1990s, a time which not coincidentally was a peak of smallholder agricultural clearing and charcoal production and thus of anthropogenic disturbance across rural landscapes, a consensus had emerged that espinal was a degradation of sclerophyllous forest (e.g. Aronson et al., 1993; Ovalle et al., 1999; van de Wouw et al., 2011). The scientific literature from this period often states that *V. caven* is invasive, without clearly distinguishing between invasive in the sense of non-native and invasive in the sense of entering and degrading other habitat types through rapid growth and competition. Effectively, *V.*

caven also occurs in the Chaco, from where it is presumed to originate (although there is no evidence as to where the species split from its very widespread sister species *V. farnesiana*). Our own research showed that *V. caven* cannot be invasive in the sense of entering and actively degrading sclerophyllous forest and is instead a slow-growing pioneer species and a nurse tree that establishes after disturbance and allows sclerophyllous forest trees to establish via succession (Root-Bernstein et al., 2017b, 2022). However, debates persist around whether *V. caven* is an invasive species in the sense of being of recent anthropogenic origin (Velasco et al., 2023; Root-Bernstein et al., 2017b).

Multi-species rewilding could be scaled up across all of central Chile

The planned corridor project proposed by Sara Larraín fits into our larger vision for scaling the project up across the region. Our full vision would also involve a second corridor of guanaco reintroduction sites in the Cordillera de la Costa that runs up and down the center of Chile (Figure 1). This region, although fragmented by agriculture and roads, also contains some large important conservation areas, for example in in the Man and Biosphere Reserve and National Park La Campana and the National Reserve Las Peñuelas; the Alhué area, Altos de Cantillana Nature Sanctuary, and Palmas de Cocolán National Park; and ideally would extend further south to around San Vicente de Tagua Tagua (where there is an important archeological site) and Santa Cruz (where there are important cultural heritage areas). This potential corridor includes areas with local endemics, and fragmented populations of rare species such as *Jubaea chilensis*. Connectivity between the two mountain corridors can potentially be created through constructing wildlife bridges over the main north-south highway. Rewilding may help to maintain the habitats supporting these species, and restore critical missing ecological functions (see above, *Restoration justification*). It could also allow integrated natural and cultural heritage tourism.

In addition, our vision for species reintroductions or translocations does not stop with guanacos and *V. caven*. Other species that we are interested in potentially seeing translocated, reintroduced, or managed in central Chile in order to bring back ecosystem functions and processes such as fire control, seed dispersal, soil nutrient cycling, shade and soil moisture provision, and so on, includes cattle and horses as proxies for extinct megafauna (including extinct horses), ñandú (rheas) *Rhea pennata*, huemul *Hippocamelus bisulcus* (Flueck et al., 2022), the Chilean palm *Jubaea chilensis*, and trees that should be particularly well adapted to increasing aridity under climate change, such as *Neltuma [Prosopis] chilensis* (Figures 2, 3) Our vision is thus of a mosaic of habitats where currently rare trees that provide ecosystem processes and economic and cultural resources are more abundant due to translocation and restored ecological functions allowing seed dispersal and germination site creation; where guanacos, Darwin's rhea and huemul forage together (Flueck et al., 2022), where cattle

FIGURE 2
Some species that we propose to reintroduce or manage as ecological proxies in central Chile. Top left: A guanaco *Lama guanicoe* released into the Andean foothills (photo MR-B). Top right: An extensively grazed cow in central Chilean woodland (photo MR-B). Bottom left: rhea *Rhea pennata* (photo CHUCAO, CC BY-SA 3.0 <https://creativecommons.org/licenses/by-sa/3.0>, via Wikimedia Commons). Bottom middle: huemul *Hippocamelus bisulcus* (photo: Secretaria de Turismo de Esquel, CC BY-SA 4.0 <https://creativecommons.org/licenses/by-sa/4.0>, via Wikimedia Commons). Bottom right: extensively grazed horses, Palmas de Cocolán National Park (photo MR-B).

FIGURE 3
Some plant species that we propose to manage for conservation and restoration and/or translocate. Left top: *espinos Vachellia [Acacia] caven*, in an early-succession *espinal* (photo: MR-B). Left bottom: Chilean *algarrobo Neltuma chilensis*, Parque Quinta Normal, Santiago (photo: MR-B). Center: native *chañar Geoffrea decorticans*, Parque Quinta Normal, Santiago (photo: MR-B). Far right: Chilean palms *Jubaea chilensis*, Palmas de Cocalán National Park (photo: MR-B).

and horses continue to be allowed to roam freely at low densities, and where pumas and condors are more abundant and primarily feed on guanacos (rather than horses as is now the case).

However, there is no scientific consensus that most the animal species mentioned here belong in central Chilean habitats, partly due to a lack of integration between paleoecology and conservation biology in Chile, and the relatively limited paleoecological and historical data on species distributions (Root-Bernstein et al. submitted). This vision is speculative and generates a series of scientific hypotheses that orient our further research, rather than imposing a pre-determined outcome.

Involvement of local communities is essential

Principles 6, 7, and 10 of the IUCN's principles of rewilding call for engagement with society and local communities (IUCN Rewilding Thematic Group, 2018). Community engagement is also crucial for reintroductions and translocations (Consorte-McCrea and Bath, 2020). We follow Consorte-Crea and Bath's (2020) recommendations through interdisciplinary and social science research and involving local actors in project consultation and co-construction (e.g. Lindon & Root-Bernstein, 2014; Root-Bernstein et al., 2020, 2022; Guerrero-Gatica et al., 2023). Co-construction refers to a set of best-practice processes taking into account gender and other social inequalities, that engages stakeholders in contributing their local or traditional knowledge towards producing new applied knowledge, research hypotheses, and project goals, with high social legitimacy and relevance (Jagannathan et al., 2020; Latulippe and Klenk, 2020). Community conservation, defined as the devolution of decision-making to stakeholders, avoidance of elite capture, the use of standards and regulations to increase accountability, and the inclusion of adaptive learning mechanisms for management (Ribot et al., 2010; Brooks and Waylen, 2012), posits that local people need to be involved in restoration and conservation projects (Berkes, 2004; Brockington, 2004; Danielsen et al., 2007; Brooks and Waylen, 2012). Since early on in the project, we imagined a desirable scenario in which the central Chilean landscape would be more ecologically connected, for example via a regionally self-coordinating system of semi-wild guanaco transhumance (Root-Bernstein et al., 2016; Root-Bernstein and Svenning, 2017). It is vital to safeguard the local ecological knowledge that has been and is still formed through peasant livelihoods (Berkes, 2004; Aswani et al., 2018; Albuquerque et al., 2021).

Integrating sustainably managed traditional resource use may be expected to increase positive perceptions of restoration and conservation initiatives by local populations (Root-Bernstein and Frascaroli, 2016). However, community-based natural resource management projects have a poor record of delivering their social and ecological goals (Kellert et al., 2000; Dressler et al., 2010). The adaptive capacity of relevant institutions may be crucial (Armitage, 2005). Institutional reform is a complex, society-wide issue that may be beyond our direct influence. Moreover, community conservation and community-based natural resource management approaches

TABLE 1 Evaluation of our application of the principles of rewilding, following IUCN Rewilding Thematic Group (2018).

Principle of Rewilding	Description	How we apply this principle	Stage of achievement
1	Rewilding utilizes wildlife to restore trophic interactions	Guanaco reintroduction to browse *V. caven*. We are also interested in other species, and in non-trophic interactions.	Pilot release implemented. Full reintroduction not implemented. Full set of evidence for expected ecological interactions not completed.
2	Rewilding employs landscape-scale planning that considers core areas, connectivity and co-existence.	We have not carried out a formal land use planning study, but we have analyzed connectivity between woodland types and potential for guanaco movements between them. Our vision includes protected areas, landscape connectivity, and co-existence with humans (Figure 1).	Land use planning study not implemented. Land use plan not implemented.
3	Rewilding focuses on the recovery of ecological processes, interactions and conditions based on reference ecosystems.	We are currently developing historical and paleoecological baselines for reference ecosystems. We hypothesize that guanacos (and other species) can contribute to ecological processes such as fire control, seed dispersal, nutrient transport and recycling, shade and soil moisture retention.	Baselines from reference ecosystems not completed. Study of recovery of ecological processes in progress. Recovery of ecological processes not implemented.
4	Rewilding recognizes that ecosystems are dynamic and constantly changing.	We are not committed to compositionalist values.	Our commitment to this principle is ongoing and guides our work.
5	Rewilding should anticipate the effects of climate change and where possible act as a tool to mitigate impacts.	We have not worked explicitly on this issue at this time.	Not implemented.
6	Rewilding requires local engagement and support.	We use a co-production approach and work with local ecological knowledge. Our strategy involves developing broad social consensus. We engage in outreach to the public through social media, magazine and newspaper articles, participation in local festivals, etc. We have support from a broad range of stakeholders and actors.	Local engagement and support are in progress.
7	Rewilding is informed by both science and indigenous and local knowledge.	We use a co-production approach and work with local ecological knowledge. We actively produce scientific hypotheses and research to better understand social and ecological aspects of the context.	Some scientific studies have been completed. Other scientific studies have not been completed or started. Co-production of knowledge working with local ecological knowledge holders is ongoing.
8	Rewilding is adaptive and dependent on monitoring and feedback.	We were not able to fund monitoring of the pilot reintroduction.	Not implemented.
9	Rewilding recognizes the intrinsic value of all species and ecosystems.	We draw on intrinsic values of nature, as well as other values and justifications, some of which are anthropocentric.	Informs our ongoing work.
10	Rewilding requires a paradigm shift in the co-existence of humans and nature.	We work towards "providing optimism, purpose and motivation" by circulating our vision of how central Chile could be in the future, in ways that imply a paradigm shift. We have generated a shared consensus around certain issues and public fora for debate about guanaco rewilding. Our engagement with controversies can be seen as contributing to transformative change (Skrimizea et al., 2020).	Informs our ongoing work. Not achieved.

lack clear theories of change or hypotheses that could help identify leverage points (Root-Bernstein, 2020) and are rarely properly evaluated especially when they fail (Catalano et al., 2019), factors that together reduce learning opportunities that we can draw on. Due to the lack of best-practice guidance, and the bottom-up nature of a co-construction approach, we do not currently know exactly what form community conservation will take in our project. Despite these uncertainties, we believe that the risk of failure of community-based natural resource management is justified on ethical grounds, as an aspect of environmental and social justice (i.e. access to traditional peasant livelihoods) (Martínez Alier, 2002; Dressler et al., 2010; Kay, 2014).

In the context of our collaboration with the Cascada de las Ánimas Nature Sanctuary, we have begun to engage with the local community in order to co-produce an approach to rewilding in the area (Guerrero-Gatica et al., 2023). In our initial vision, which will be modified through co-production/co-construction methods, local people would be legally permitted to sustainably harvest natural resources, and to carry out traditional management practices. Access to land on which these practices can be carried out can be obtained through agreed management plans on public and private lands, and through strengthening and negotiating traditional access rights. Adaptively managed traditional management practices (Berkes, 2004) may also help to replace the missing ecosystem processes of extinct megafauna for which there are no other realistic proxies (Root-Bernstein and Ladle, 2019). Ideally these harvesting and managing practices would be carried out through bottom-up collective action, much as they were in the past (Moyano Altamirano, 2014; MR-B unpublished material). The shearing of guanaco fiber could also be managed by local collectives. When population sizes of reintroduced animals are large enough, regulated hunting could be allowed. We are also interested in investigating whether it would be a good idea to promote llama or alpaca raising, which is rare in central Chile, but which might provide many of the same ecological functions as guanacos, in contexts where it is impractical to introduce wild camelids.

Communities are not uniform (Titz et al., 2018) and social life involves tensions (e.g. Le Billon and Duffy, 2018). There is always a risk of social tensions associated with every conservation, restoration, and rewilding project. Engaging in co-construction and community conservation may reduce but does not eliminate the risk of social tensions associated with a project. Projects can cause conflicts, but they may also be lightning rods for the expression of pre-existing tensions and conflicts (e.g. Krauss, 2005; Douglas and Veríssimo, 2013). As Bourdieu has pointed out, it is not possible for everyone to always perform socially in a way that no one can criticize (Bourdieu, 2018). Negotiating the variety of conflicts that may arise during a long term project is an art.

Evaluation of our project and vision

There are multiple frameworks that could be used to assess the success of a rewilding project (Beyers and Sinclair, 2022; Root-Bernstein, 2022). A process-based rather than outcome-based assessment consists of evaluating how we meet the principles for rewilding as described by the IUCN (IUCN Rewilding Thematic Group, 2018; Carver et al., 2021). The IUCN working group on rewilding gathered input from a variety of rewilding researchers and practitioners around the world, including a representative of Kintu (MR-B), to come up with a consensus list of rewilding principles. Although not all rewilding projects necessarily conform to these principles, we are satisfied by the principles and find them appropriate to apply to our own project. We assess how we meet these principles in Table 1. From an outcomes perspective, the project is innovative within its context, and thus has a very high risk of failure. Objectively, we have none of the resources that characterize successfully implemented rewilding projects, such as control over a large landholding and budget (Root-Bernstein et al., 2018), and we have not advanced beyond a proof-of-concept pilot reintroduction. On the other hand, vision-led rewilding projects are often able to overcome hurdles and setbacks (Root-Bernstein et al., 2018; but see Theunissen, 2019). Optimism and hope are part of our strategy and vision. A successful aspect of our strategy has been to circulate speculations, arguments, hypotheses and evidence about how the central Chilean landscape could be restored. This has resulted in identifying a range of collaborators and stakeholders who share our vision and are interested in testing our hypotheses, and whose capacities complement ours.

Finally, it almost goes without saying that this is not a top-down vision that we will impose on local people, and that our commitment to safeguarding the value of local ecological knowledge and local management traditions imply a co-production approach to the project (Jagannathan et al., 2020; Norström et al., 2020; Guerrero-Gatica et al., 2023). The project depends entirely on the building of a broad consensus for a shared vision (which undoubtedly will be a modification of our current vision) and on diverse local actors helping to overcome our lack of capacity by taking the initiative and making the project their own.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary Material. Further inquiries can be directed to the corresponding author.

Author contributions

MR-B: Conceptualization, Writing – original draft, Writing – review & editing. MG-G: Visualization, Writing – review & editing.

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Conflict of interest

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fcosc.2024.1441980/full#supplementary-material

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