

Geodiversity meets Biodiversity: a landscape approach for biogeocultural conservation and governance in Mediterranean central Chile

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Abstract

Biodiversity has gained huge importance as a fundamental concept for environmental conservation, yet the physical support of biodiversity (e. g., soils, landforms and geological units, recognized as geodiversity) remains little observed within the scientific community. At the same time, advances in effective biodiversity conservation in critical hotspots, as in Central Chile, are limited due to the lack of public lands, direct impacts on biodiversity like urban sprawl and wildfires, and the weakness of governance approaches for effective conservation planning. Here we discuss possibilities for improving bio(geo)cultural conservation in Mediterranean Central Chile through a landscape approach.

Profile

Protected area

Biogeocultural sites in the Valparaíso region

Mountain range

Andes, Chile



Figure 1 – Belloto del Norte (*Beilschmiedia miersii* (Gay) Kosterm.), endangered Mediterranean tree, declared a Natural Monument (Decree n° 13, Ministry of Agriculture, March 1995).

Introduction

Mountain regions, and especially those in wet tropical latitudes, are marked by pronounced topoclimatic gradients, topographical heterogeneity, and various soil types that can support high species diversity (Matthews 2014). The variations stemming from heterogeneous topography are known as geodiversity. This same geodiversity encourages diversification, niches

and allopatric speciation, driving high levels of endemism (Barthlott et al. 2005). This extraordinary interplay between geodiversity and biodiversity is especially evident in the tropics, though much less so in more arid, extra-tropical latitudes. However, there is growing evidence for high levels of diversity and endemism in various plant and insect groups (Caterino 2007; Jaskula 2015) at different altitude levels (Pauli et al. 2012). This is the case for Mediterranean ecoregions, which have also been recognized as some of the most endangered biodiversity hotspots (Zachos & Habel 2011; Médail & Quézel 1999).

Mediterranean ecosystems have been suffering constant environmental degradation through a process termed *neo-technological landscape despoilation* (Naveh & Lieberman 1994), a salient indication of the global environmental crisis. The environmental degradation is compounded by population growth and the land-use pressures of increased tourism, industrial and agricultural land expansion, and urban sprawl; at the same time, other areas suffer from depopulation and land abandonment (Naveh 2007).

There is one such hotspot in Mediterranean central Chile. Spanning many latitudes, its gradient ranges from hyper aridity in the south of the Atacama Desert to temperate forests in Valdivia (Figure 2). Although this vast area is not particularly known for its species richness, the degree of endemism (especially at the genus level) is highly remarkable (Moreira-Muñoz 2014). The highest level of endemism reported for vascular plants is that of the semi-desert scrub and sclerophyllous forests in the coastal-mountainous core of the hotspot (Moreira-Muñoz 2014). This endemism is related to the landscape's heterogeneity, to evolutionary processes, and to historical biogeography (Moreira-Muñoz 2011).

Central Chile is also considered the country's most threatened landscape. Be it through urban sprawl,

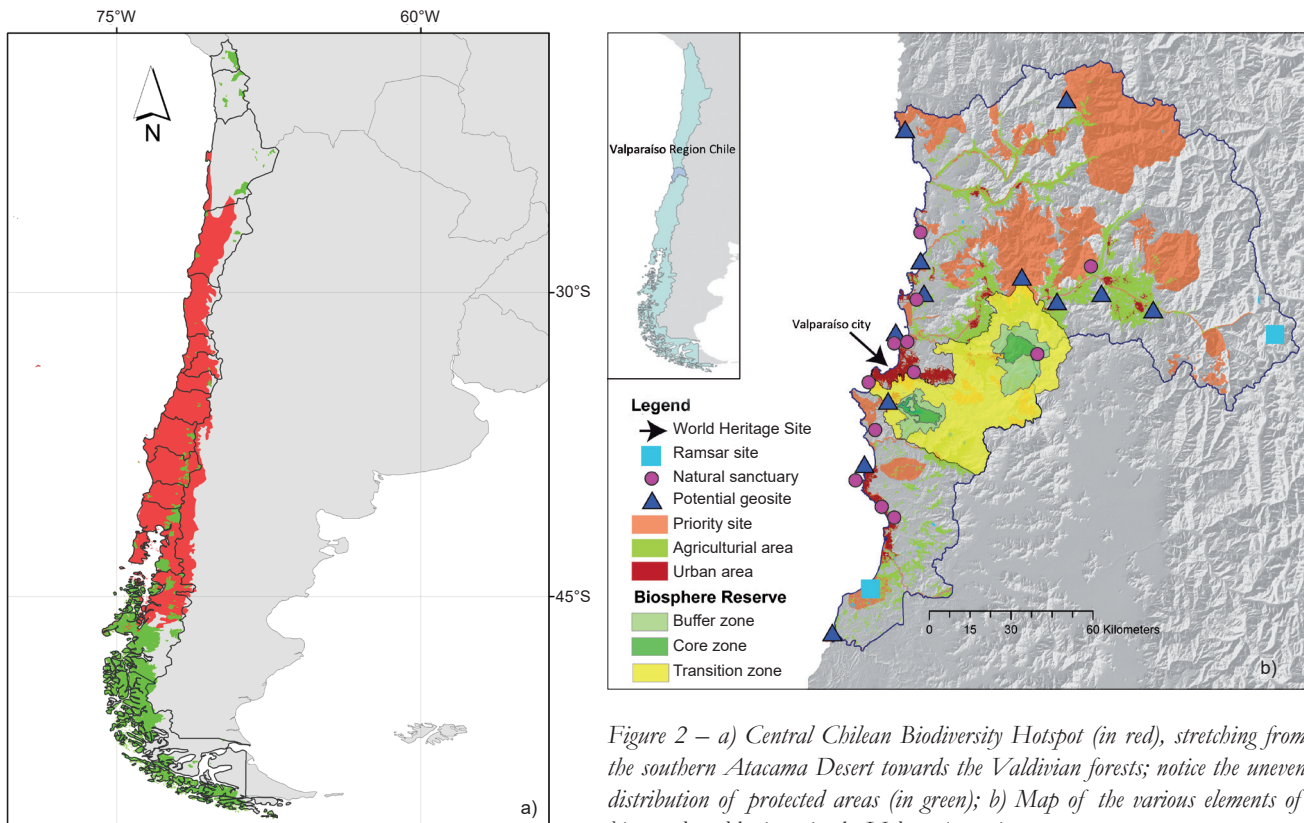


Figure 2 – a) Central Chilean Biodiversity Hotspot (in red), stretching from the southern Atacama Desert towards the Valdivian forests; notice the uneven distribution of protected areas (in green); b) Map of the various elements of biogeocultural heritage in the Valparaíso region.

wildfires, traditional agriculture uses and/or infrastructure projects, many conflicts arise between human land uses and biodiversity conservation, especially at the periurban fringe (Salazar et al. 2015). The core of the biodiversity hotspot is found in the Valparaíso region (Figure 2), which has the most evident protection deficit for protected areas.

Based on these issues, this report discusses the means to improve protection for bio- and geoh heritage, without eschewing cultural, historical or spiritual values, through a landscape-level approach and through biogeocultural heritage governance.

Where geo- and biodiversity meet: biogeocultural conservation

Although there has seemingly long been interest in cultural heritage, the recognition of global heritage was only truly made concrete after World War II, when the massive destruction of cultural treasures was patently evident. That abrupt awakening from what had been a slowly evolving transition led to the first protocols for heritage maintenance through the 1954 Hague Convention, followed by the Venice Charter for the Conservation and Restoration of Monuments and Sites in 1964.

The Convention on the Protection of World Cultural and Natural Heritage was adopted by the UNESCO General Conference in 1972 and considered natural and cultural heritage together as a homogeneous whole. Still standing today, the convention defined

physical and biological formations with proven universal aesthetic or scientific value as natural heritage. Geological and physiographic formations, as well as habitats for endangered species, are considered potential Natural Monuments. Within Latin America, countries which rapidly adopted these principles were Chile and Argentina (Pastor 2014).

The UNESCO classification has not been underutilized: Chile is home to six cultural World Heritage sites, including the historic centre of Valparaíso (Figure 3). Another, more recent, inclusion as a UNESCO Intangible Cultural Heritage of Humanity is the *Baile Chino*, a Central Chilean cultural tradition that includes music, dance and singing related to religious beliefs (UNESCO 2014). The aim of integrating cultural and natural values appears in yet another UNESCO category: Biosphere Reserves (BR), part of the Man and the Biosphere Programme. In Chile, the Campana-Peñuelas BR has belonged to this world network since 1984. In 2009, the BR's limits were expanded through a new zoning scheme (Negrete et al. 2010) (Figure 2).

Long before Campana-Peñuelas BR was established, however, Chile legislated for the establishment of the Council of National Monuments, in 1925. The Council's purview includes cultural heritage (Historic Monuments) and natural heritage (Natural Monuments and Natural Sanctuaries). The Campana-Peñuelas BR includes several Natural Sanctuaries under the supervision of the Council of National Monuments (Figure 3). This legal entity also has the power to declare a single species as natural heritage: six trees

from the central Chilean ecoregion have earned this designation, including belloto del norte (*Beilschmiedia miersii* (Gay) Kosterm.), an endangered tree from the Lauraceae (Figure 1); or, since 2008, all 43 cetacean species living in Chilean Pacific waters (Biblioteca del Congreso Nacional de Chile 2008). For the Valparaíso region taken as a whole, the Council of National Monuments has designated 13 Natural Sanctuaries and one Natural Monument. The Natural Monument is the Isla Cachagua, which was protected in 1989 as 4.5 ha for the conservation of Humboldt penguins (*Spheniscus humboldti*). The region also harbours two Ramsar sites: El Yali lagoon in the south, and the Parque Andino Juncal in the high Andes.

In spite of such efforts, less than a 1% of the Valparaíso regional territory is under formal protection, while other complementary private natural sanctuaries are failing to fulfil their conservation goals (Borsdorf et al. 2016). Around 15 potential natural heritage sites in need of protection have been identified in the Valparaíso region, including the paleontological site *Los Maitenes de Puchuncaví* (Andrade et al. 2009), or Los Molles priority site (Figure 3). However, an enormous amount of field work remains to be done to identify similar sites among coastal cliffs and dunes; Andean volcanic, periglacial, and glacial formations; and transitional geo-forms such as cordillera granite outcrops, sedimentary basins or fluvial terraces, among others.

This problem is not unique to Chile; countries throughout Latin America have organized regional meetings focusing on frameworks to identify and assess geological and geomorphological heritage sites. Some of the main geo-concepts to have arisen from these meetings include geo-heritage, geo-conservation, geo-tourism and geo-parks (Palacio et al. 2016).

Proposals for the application of these concepts in Chile have already been put forward (Schilling et al. 2015), and in May 2017, the Global Geoparks Network of Latin America and the Caribbean, supported by UNESCO, was created in Achoma, Peru (UNESCO 2017). The field of geo-conservation thus looks set to study and improve upon the interplay between geo- and biodiversity conservation.

Biogeocultural heritage governance at the landscape scale

Biodiversity, geodiversity and cultural diversity converge in Mediterranean Chile, but the available surface results in a bottleneck for heritage protection: effective protected areas in Chile are on public land, yet there is not much public land available for conservation at the core of the hotspot. With new forms of sustainable economic development related to this heritage being explored, private land may yet come into play; for now, however, private land owners see heritage protection as a barrier to economic growth. For instance, in Valparaíso urban heritage sites, historic monuments suffer continuous damage when private owners do not



Figure 3 – Various aspects of biogeocultural heritage in the Valparaíso region: Los Molles, a priority conservation site encompassing current endemic flora and Triassic paleodeposits (top); La Campana National Park, the core of the Biosphere Reserve (middle); Valparaíso city, a cultural World Heritage Site (bottom). © Moreira-Muñoz and Manríquez

wish to dedicate resources for extensive renovation. Natural Sanctuaries, like the Concon dunes, are also at the mercy of economic influences when real estate developers interested in maximizing profits erect huge buildings, transforming landscapes from areas of high environmental value into areas of private consumption (Figueroa-Sterquel et al. 2016), homogenizing and fragmenting the landscape to the detriment of public interest and bio(geo)heritage (Figure 4). Even locations that



Figure 4 – Biogeocultural sites under threat: Concon dunes threatened by urban growth (top) © Moreira-Muñoz; Los Maitenes wetland in close proximity to the Ventanas industrial complex (bottom) © Manríquez

have been placed in categories of global importance, like the Campana-Peñuelas BR, are in permanent danger due to wildfires (Salazar et al. 2015) or imminent electricity infrastructure projects. Compounding the problem, unprotected (but identified) geosites are not immune: *Puchuncaví*, for example, is in close proximity to one of the most polluted sites in Central Chile, the *Ventanas* industrial complex (Figure 4). These examples of fragmentation in heritage conservation are indicative of the need for integrative, holistic conservation and sustainability, and of the current gap in biogeocultural conservation at the landscape scale.

In tackling this biogeocultural conservation problem, researchers have stated that sustainable development should have at its core the goal of maximizing biodiversity (Laladhas et al. 2017). Protecting biodiversity, according to Rockström and Sukhdev (2016), is crucial enough to call for the reorganization of even the Sustainable Development Goals (SDGs). Biodiversity is also the main goal of the broader concept of conservation as promoted by the UNESCO Man and the Biosphere Programme in its BRs Network. The goal of the network specifically includes aspects of (sustainable) human development and scientific re-

search. Note the intertwining of biodiversity and sustainability: the global BR network is meant, in fact, to function as *laboratories for sustainability*.

Protected areas are not islands, however, separate from their surroundings and human activities. Chile harbours 10 BRs, from the high northern Altiplanic altitudes to sub-Antarctic waters (Moreira-Muñoz & Borsdorf 2014), but these reserves still require further conservation efforts. In terms of biocultural conservation, for example, some advances have been made at the Cabo de Hornos BR (Rozzi 2013). However, biogeocultural conservation efforts in BRs are much more evident in Europe than in South America, as seen in pan-European instruments like the European Landscape Convention (Casale et al. 2014).

In this sense, a landscape approach for heritage conservation and planning would be appropriate. First, a landscape approach promotes a category of geographical analysis that goes beyond the culture–nature dichotomy, maintaining unity while promoting conservation strategies (Görg 2007). Second, because the landscape gives value to the observer, their experience and their interpretations of the environment, it allows them to recognize the at-times conflicting spatial representations of multiple actors, promoting a social co-creation of the landscape (Buizer et al. 2016). And third, the landscape concept provides vertical integration: minor landscapes are contained within major landscapes.

This requires several governance protocols and strategies that are especially adaptable to the landscape scale (Low 2013; Görg 2007). These protocols concern not just traditional landscape elements, but rather include invisible landscapes such as tradition, religions and culture. Examples can be found worldwide and include the Balinese water temples (Lansing & Kremer 1993) or numerous endangered sacred places (Bhagwat et al. 2005; Verschuuren et al. 2010).

The human dimension of biogeocultural heritage conservation presents a challenge. There are considerable pitfalls relating to power and decision structures common to the globalized, neoliberalist context (Svampa 2013; Gudynas 2009). Notwithstanding, frameworks have recognized that “*protected landscapes and cultural landscapes share much common ground: both are focused on landscapes where human relationships with the biotic and abiotic natural environment over time define their essential character*” (Janssen & Knippenberg 2012). In the Chilean case, these relationships are still commonly perceived as conflicts, as diverging interests, as non-compatible extremes between development and sustainability. Thus, there is a need for a governance approach that incorporates territorial governance strategies and promotes dialogue and consensus between actors (Figuroa-Sterquel et al. 2018).

2018 is the European Year of Cultural Heritage; it therefore seems timely and appropriate to promote a wider discussion with an international audience about the need for integration among the different forms

of heritage. Ecosystem resilience and adaptation to climate change require a definitive reconciliation between human activities and the natural processes that support life on earth.

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