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# Overlapping protected areas and other designations in Central Chile: A multiscale governance analysis

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**Abstract:** The protected areas have four types of governance in multiple scales: government, private, community, and shared. However, the lack of coordination among these has hindered the effectiveness of nature heritage protection efforts. This issue becomes apparent when protected areas overlap with other designations, resulting in a variety of regulations and administrators. Chile's central zone there is overlapping in different protection units seek to compatibility the urban and productive growth with the protection of natural heritage. The analysis of synergies and/or duplications in protected areas' overlaps with a multi-scale governance approach was the focus of the study. For this, was combined SIG analysis and review governance and protected areas' rule system using secondary information sources. The results show that, out of 40 protection units, there are 88 spatial overlaps. Reviewing the case of overlapping in Sanctuary Nature Cerro El Roble, some duplications found were: 1) redundant protection functions distributed in different government sections; and 2) the regulation system does not generate accumulative protection benefits when designations are overlapped. On the other hand, synergies were: 3) a combination of global, regional and/or local protections makes more visible the relevance of protecting. The shared governance between private, local and government agents can be seen as a synergy and duplicity to protection. It is recommended to develop mixed regulatory models that consider both state regulations at different levels and contributions from the private sector. In this point, is crucial to emphasize that overlap can be a beneficial strategy to create synergies, as long as the different protection efforts and interests among stakeholders are effectively coordinated and aligned.

**Keywords:** Overlap; Protected areas; Multiscale governance

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## 1. Introduction

Since approximately a century ago, the management of natural heritage through protected areas in Chile has been in charge of different social spheres. In this way, it is possible to discuss four types of protection governance: Government governance, private governance, community governance, and shared governance (Sierralta et al., 2011; Borrini-Feyerabend et al., 2014). Nonetheless, the lack of articulation among these representative spheres has undermined the positive effects of nature heritage's protective efforts. This phenomenon is even harder when basic elements, such as management plans or addressing critical threats are not aligned among these groups (Deguignet et al., 2017).

In addition to the aforementioned, it has been found that the set of rules that regulate protected areas partially addresses the ecosystems' integrity and their conservation needs, allowing human pressure and productive activities on protected area designations (Jones et al., 2018).

In general terms, Chilean legislation lacks an integrated, clear, and coherent system to protect these areas. The facts indicate quite the opposite; regulations and people in charge of this field have disjointed approaches regarding this matter. Hence, what remains is a sense of uncertainty concerning who might be in charge of the creation and monitoring of these areas and which activities should be prohibited or allowed in these places (Precht et al., 2016, 81).

This issue is evidenced when protected areas of natural heritage overlap with other protected area designations, regulations within the local set of rules, and administrators. This protected area overlapping represents a common phenomenon for national, global, and local protection attempts (Liu et al., 2022). There are some Latin American countries with national system of protected areas, including subsystems under national (federal), subnational (departmental/state/provincial), municipal (local) and private jurisdiction (Elbers, 2011). Therefore, it can be stated that the multi-scale governance framework is the most appropriate approach to understand the synergies and duplications produced during protection processes at different levels, with a diversity of participants, and sets of rules, as it allows the opportunity to find mixed regulatory models (Nancucheo et al., 2019; Cárdenas, 2014; García & Jiménez, 2010).

The multi-scale governance approach is related

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to the protected area's spatial dimension, concerning different agents' protection efforts through international agreements at the global level, the implications of the national and regional legislation, and finally, their social and ecological impacts at a local level (Nancucheo et al., 2019). This scale is understood as an observation or dimension unit to measure and study a certain phenomenon (Gibson et al., 2000, 128), which helps to analyze governance because it allows the analysis of spatial scales and formal administrative and legal regulations in scales frameworks (Poteete, 2012).

This protected area overlap can produce positive effects and synergies to natural heritage insofar as coordination and cooperation among agents and regulations prevails (Rivera & Vallejos-Romero, 2015). Thus, it is important to analyze the variety of governances – Government, private, local, and shared governances – as well as the different legal effects of the regulation system for each protected area designation (Muñoz et al., 2019).

In Latin America it is possible to find overlapping scenarios of protected areas between different scales and types of governance. An example is the case of Colombia, where there is a significant number of protected areas on local indigenous lands, which has caused territorial overlap that has led to conflicts between the governance of the Government and local communities (Galvis & Martínez, 2016). Chile suffers from the effects of protected areas overlapping too, as different protection units with a variety of governances – Government, private and community governance – that have been identified. There are clear overlaps depending on demarcation, the set of rules and the different agents involved (Ministerio del Medio Ambiente – ONU Medio Ambiente, 2020).

In the central area of Chile, a continuous conflict has been identified in this area of the country due to differences in the interests of the diversity of

agents and types of governance involved in this matter. On the one hand, some agents promote economic, urban and productive growth. On the other hand, others promote the protection of the endemic and autochthonous natural heritage of the Mediterranean ecoregion (Manriquez et al., 2019).

*Governance of protected areas*

Governance is understood as a coordination model among actors from different spheres of society who work to solve common problems, relying on negotiation and the exchange of resources such as information, financing, support, or collaborative work (Glückler et al., 2019; Mayntz, 1993). Besides, the formal rules and regulations established by the State become relevant in strengthening such coordination. These rules determine powers, access to financing or information, conditions for sanctioning, and monitoring in case of non-compliance with agreements (Östrom, 2005).

An analysis of governance could identify challenges in a coordination between public-private interests and resources, aiming to improve the efficiency of implementation (Pierre & Peters, 2000, 20), in this case, regarding natural heritage protection. A study of governance can provide a better understanding of the management of protected areas, presenting an opportunity to determine the relevance and equity of decisions among actors, ensure that protected areas are better integrated into society, provide assistance in addressing ongoing global change, among other benefits (Borrini-Feyerabend et al., 2014). Furthermore, governance is a field of study that is integrated as one of the obligations for countries that are party to the Convention on Biological Diversity (CBD), which Chile ratified through Decree N°1.963 in 1995, issued by the Ministry of Foreign Affairs.

Governance types	Definition	Examples
<b>Government governance</b>	Ministry or national/federal agency in charge; subnational ministry or agency in charge; government-delegated management	<ul style="list-style-type: none"> <li>• Ministry of the Environment or in charge of environmental policies and nature protection</li> <li>• State agency responsible for certain protected areas</li> </ul>
<b>Shared governance</b>	Collaborative governance; joint governance; transborder management; pluralistic decision-making	<ul style="list-style-type: none"> <li>• Permanent worktable of multiple levels and different international borders</li> <li>• Public-private alliance</li> </ul>
<b>Private governance</b>	Conserved areas established by individual landowners; by non-profit organizations; by for-profit organizations	<ul style="list-style-type: none"> <li>• NGOs</li> <li>• Universities</li> <li>• Cooperatives owners</li> </ul>
<b>Indigenous peoples' governance, and/or local community governance</b>	Territories and conserved areas by indigenous peoples; territories and conserved areas by local communities	<ul style="list-style-type: none"> <li>• Indigenous communities</li> <li>• Local civic organizations</li> </ul>

Table 1. Definition and examples of governance types.  
Source: Own elaboration based on Borrini-Feyerabend et al. (2014).

To study the governance of protected areas, Borrini-Feyerabend et al. (2014) from the International Union for Conservation of Nature (IUCN), suggests to understand different types of governance, including Government governance, shared governance, private actor governance, indigenous peoples' governance, and/or local community governance (Table 1). These types of governance are based on attributes of power and responsibility in decision-making regarding protected areas. When examining these types of governance for protected areas, it is relevant to consider key aspects such as the relevance of the extension and perimeter of the area to be conserved, the rule system, the administration, and the available human resources, among others (Borrini-Feyerabend et al., 2014).

The protected areas across Latin America exhibit a diversity of governance types for their management and protection. Some countries have made significant progress in diversifying these systems incorporating a mix of governance structures involving public, private, indigenous, and local community. It's important to note that national protected areas aren't always under the exclusive management of a single governmental institution; in some cases, as seen in Belize, multiple authorities oversee distinct management categories (Elbers, 2011). In another case, such as in Peru, private protection has increased considerably in the last decade, due to the creation of a national system of protected areas that integrates this governance (Borg, 2022).

In the protected areas of Chile, a series of difficulties and issues have been identified regarding governance by the government and private actors (Schutz, 2018). Protected areas managed by government (State) have shown weaknesses in the conservation of natural heritage, reflected in the lack of representation of ecosystems and species in these areas (Urbina-Casanova et al., 2016). For example, it has been found that only three out of eight ecosystems in central Chile are represented in the National System of Protected Areas (SNASPE), and in all cases, the represented area is less than 1% (Alaniz et al., 2016).

On the other hand, the overlapping of government-protected areas can exacerbate the duplication of protection functions, where there is already a lack of alliance and/or coordination between institutions and within them. This also affects the invested public financial resources, which become disjointed and fail to give positive results despite the initial effort (Contreras et al., 2015, 697). Additionally, different environmental sectoral organizations such as the National Forestry Corporation or the Environment Ministry have limited capacity to contribute to the protection-rich areas on private property (Jorquera-Jaramillo et al., 2012).

This situation is unquestionable due to the lack of an institution to lead protection, such as the Biodiversity and Protected Areas Service (SBAP), despite the fact that it should have been created in 2010 as a result of the indications of Law 20.417, which established public institutions in this area (Senado de la República de Chile, 2019). Approved in June 2023 (Cámara de Diputados

y Diputadas, 2023), this entity presents within its guidelines to create an integrated National System of terrestrial and marine protected areas, from public and private efforts, in order to unify the regulation, administration and management of protected areas (Boletín 9404-12, 2014).

Private sector involvement has been seen as an option to fill the gaps that the public or government system has been unable to address in terms of natural heritage protection, such as providing sufficient funding and holding land tenure in priority areas for nature (Figgis et al., 2005; Mitchell et al., 2018). In response to this, an alternative is seen in extending governance beyond the public sector and involving landowners, corporations, communities, non-governmental organizations, among others, to generate legitimate conservation efforts in a context where the neoliberal model and private property prevail (Borrie et al., 2020).

Protected areas managed by local communities represent an opportunity to expand protection by incorporating their values, meanings, and management practices at a scale closer to natural heritage (Ayivor et al., 2020). When there is collaboration between the local community, private actors, and the government, it becomes possible to make more contextually relevant conservation decisions while satisfying the socio-economic needs of a territory (Meffe et al., 2002).

#### *A multi-scalar approach as an analysis of overlap*

The multi-scale approach contributes to the understanding of territorial planning for the integration of protected areas, considering the diversity of actors involved in management and the formal rules provided by legislation. It aims to identify synergies or duplications when overlapping different types of designations and scales of protected areas within the same spatial observation unit (Deguignet et al., 2017).

Regarding the latter, synergies are understood as the coherent, concise, and clear relationship among protected areas, allowing for the effective implementation of conservation exercises or action plans at different scales within the same spatial unit. Instead, duplication implies the repetition of the same functions in different areas of protection, leading to the erosion of conservation efforts across multiple scales (García & Jiménez, 2010).

Maintaining the concept of synergies and duplications, it is possible to examine the combination of actors involved in the governance of protected areas, where representatives from the government, private actors, and local communities can be found within the same spatial unit (Deguignet et al., 2017). The combination of these actors can occur at the same scale or across different scales within the framework in which they were declared, such as the global, national, or local scale (Nancucheo et al., 2019). In this context, a synergistic articulation can occur through the combination of multiple actors at different scales, enabling the exchange of political, technical, or financial resources. This,

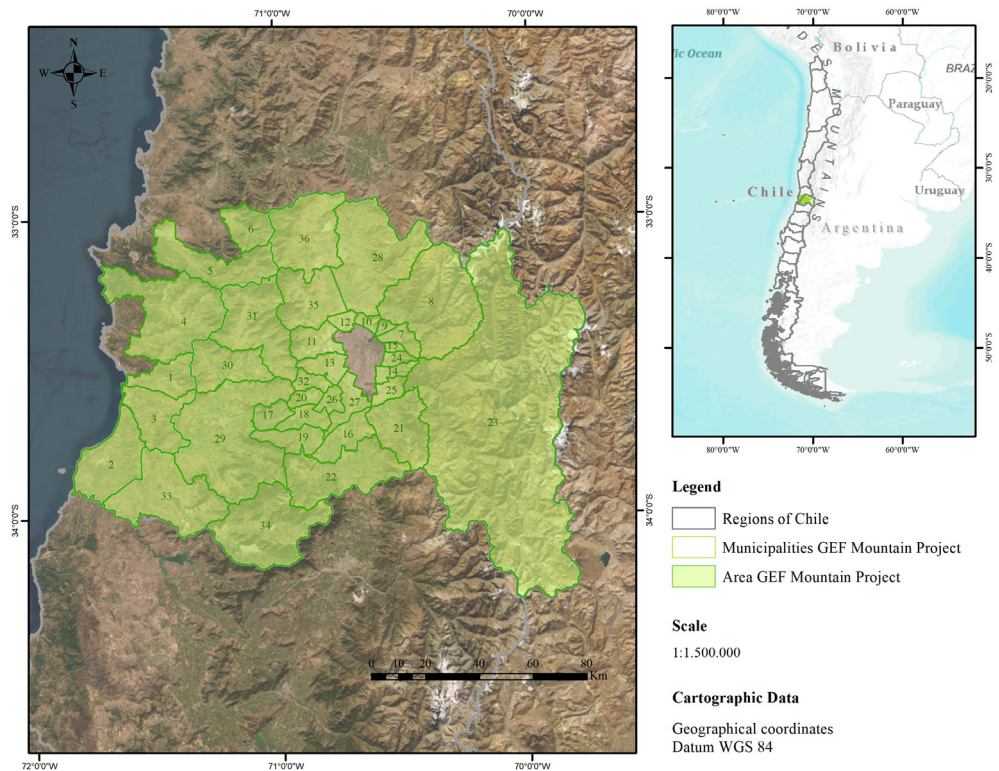


Figure 1. Study area.  
Source: Own elaboration (2023).

at the same time allows the improvement of natural heritage protection (Borrini-Feyerabend et al., 2014).

In the case of Chile, it is more common to find duplications, especially due to difficulties in coordinating government public management, the assignment of similar functions to different agencies, a lack of clarity regarding environmental responsibilities, multiple rules without adhering to integrated territorial planning. This has created a complex and confusing system of protection (Contreras et al., 2015; Precht et al., 2016, 81). It is worth noting that the lack of a system that integrates and optimizes the management of protected areas is a worldwide problem, as noted by Deguignet et al. (2017).

**2. Methodology**

*Study area: Central Chile*

This research uses the proposed area in the "Planificación Ecológica a escala Local – Zona Central, Chile" [Ecological Planning at a Local Scale - Central Zone, Chile] which was developed between 2019 and 2020 by the GEF Mountain Biological Corridors Project (GEF Mountain Project) (Ministerio del Medio

Ambiente – ONU Medio Ambiente, 2020). From this project, a geospatial database was derived, which allowed for the initial findings of overlap and protected areas, facilitating the development of the research.

The study area of the GEF Mountain Project encompasses 30 communes in the Metropolitan Region and 6 communes in the Valparaíso Region (Figure 1), with a total area of 1,829,330 hectares. It is important to note that it only considered the communes located in wild areas established in the "Catastro de los Recursos Vegetacionales Nativos de Chile" [Inventory and Evaluation of Native Vegetational Resources of Chile] (Corporación Nacional Forestal – Centro de Información de Recursos Naturales [CONAF-CIREN], 2013).

This study area corresponds to the mediterranean ecoregion of Chile, also known as the central zone. It is characterized geographically by the Andes mountains, followed by an intermediate depression known as the central valley, surrounded by the Coastal range, and finally, a coastal plain along the western coast. The predominant climate is mediterranean, with different seasons, mainly with winter rainfall and high temperatures in summer, creating favorable conditions for sclerophyllous vegetation (Santibáñez et al., 2018).

The geographic and climatic characteristics have facilitated the presence of ecosystems with endemic and threatened species, which is why the central zone of Chile has been designated as a priority site for global biodiversity conservation (Myers et al., 2000). However, it also experiences a high species loss, particularly in the central valley area, where land-use change due to human activities has historically been concentrated (Fuentes-Castillo et al., 2019).

**Method**

This research used a mixed research design as described by Hernández et al. (2014), employing a quantitative approach for spatial analysis of overlap and a qualitative approach for governance, actors, and legislation of protected areas based on secondary sources of information. The main emphasis was placed on obtaining qualitative results for a critical analysis of the overlap of protected areas and the multiscale governance perspective.

The studies on the overlap of protected areas conducted by Deguignet et al. (2017), Liu et al. (2022), and Schutz (2018) were used as references for data collection, obtaining results, and analysis. The main framework of analysis focused on the following scales: global (outside Chile), national (Chile), regional (regional political-administrative division of Chile), and

local (communal political-administrative division of Chile).

To characterize the protected areas and other designations of protection, the initially reviewed those located within the 36 communes of the GEF Mountain Project and recognized in the "Registro Nacional de Áreas Protegidas de Chile" [National Registry of Protected Areas of Chile] (Ministerio del Medio Ambiente, n.d.b). In this registry, the different types of protection were classified as protected area, private conservation and other designations. Although the World Database on Protected Areas (WDPA), belonging to the IUCN, exists, only National Registry was used in order to incorporate as many designations as possible, especially those by private entities and local communities.

To characterize each unit of protected area, a literature review of geospatial information and documentation was conducted, using the following search criteria: a) scale, b) designation of protection, c) units, d) area, e) type of governance, and f) system of rules. These attributes are part of the international requirements for natural heritage conservation and have been used to examine the overlap of protected areas (Borrini-Feyerabend et al., 2014; Liu et al., 2022).

The identification of overlap was conducted through spatial analysis using ARCGIS 10.8, with reference to the vector data processing

N	Designation protection	Abbreviation (in spanish)	Protected units	Area (ha)	Governance type
<b>Scale global</b>					
1	Biosphere Reserve	RB	1	238.216,0	Government
2	Ramsar Site	SR	1	520,0	Government
<b>Scale national</b>					
3	Protected National Asset	BNP	2	30.407,3	Government
4	Natural Monument	MN	1	3.009,0	Government
5	National Park	PN	2	18.185,0	Government
6	National Reserve	RN	2	6.390,4	Government
<b>Scale regional</b>					
7	Ecological Preservation Area	APE	1	7.372.400,0	Government
8	Priority Site	SP	5	672.738,7	Government
<b>Scale local</b>					
9	Private Conservation	CP	7	7.816,3	Private
10	Municipal Nature Reserve	RENAMU	3	116,0	Government
11	Nature Sanctuary	SN	14	79.443,5	Government or Private or shared
12	Conservation Landscape	PC	1	84.500,0	Government or shared or Local community

Table 2. Protection designation attributes.

Source: Own elaboration based on Ministerio del Medio Ambiente (n.d.b) & Correa (2016).

method applied by Schutz (2018, 4). The vector data layer of protected areas and other designations was extracted from the geoportal of the National Registry of Protected Areas of Chile, complemented by the spatial registry of the geoportal developed by the GEF Mountain Project. Only continental terrestrial protected areas with polygons as the geographic information unit were considered.

The polygons of the protected areas were grouped into a vector layer. This layer was reorganized with the attributes collected from the characterization of the protected areas, including a code, name, designation type, area, governance type, scale, commune, and region for each protection unit.

The overlap was detected based on the presence/absence (binary indicator 1/0) of each protection unit, considering all types of protection designations present in the study area. This information was recorded using an overlap matrix, which allowed for the estimation of: 1) the number of overlaps in the study area, 2) the number of designations with at least one overlap, and 3) the number of overlaps for each scale of analysis.

The spatial analysis had certain limitations related to the vector layers of the study area and the protected areas, similar to Schutz (2018). The polygon overlap did not consider inaccurately drawn boundary errors for the presence/absence (1/0) accounting. Additionally, a limitation was acknowledged in the clipping of polygons that share areas outside the study area, which reduced the extension of the protected areas. Another limitation was the availability of information from the GEF Mountain Project, which is limited to the "wild" surface defined by the CONAF-CIREN (2013), preventing the inclusion of designations in rural and urban areas in the research.

The analysis of the overlap of protected areas from the perspective of multiscale governance focused on one of the overlapping zones that met the following criteria: a) had a surface area equal to or less than 1,000 hectares, b) contained the highest amount of overlap (hectares), and c) represented different scales and types of governance. These criteria were defined to delimit the spatial observation unit. In this zone, a critical analysis was conducted based on the synergies and/or duplications of the overlap, following the definition of García & Jiménez (2010) regarding attributes, focusing on the types of governance and rule systems of the protected areas.

### 3. Results

#### *Overlapping protected areas and other designations in Central Chile*

Within the 36 communes of the GEF Mountain Project, 40 spatial units of protection were identified, corresponding to 12 types of designations at different scales (Table 2). The list of reviewed protected areas and other designations can be found in Appendix 1. It is

important to note that "protected units" refers to the individual spatial unit with protection, while "designation of protection" refers to the legal designation of protection. For example, Table 2 shows that the designation "Protected National Asset" is assigned to two spatial units of protection.

The spatial overlap analysis of the study area revealed that 90% of the units (36) had more than one designation or category for protection, while only 10% of the units (4) had no overlap. These proportions were similar to the studies conducted by Deguignet et al. (2017) and Liu et al. (2022), especially in the case of Liu et al. where the percentage of overlap was over half of the protected areas (52.9%). The units of protection that did not have this condition correspond to Nature Sanctuaries linked to wetlands and the foothills of the central valley. These areas have been recently declared within the last eight years.

A total of 88 overlaps were recorded among all protected units, considering the different overlapping designations (Table 3).

The overlapping of protected units among designations was distinguished, with Ecological Preservation Areas (APE) having the highest number of overlaps, with a total of 21. They were followed by Priority Sites (SP) and Nature Sanctuaries (SN), both with 17 overlaps. Regional designations, particularly APE, accounted for the largest surface areas, with 7,372,400 hectares, representing 23,9% of the overlap in the study area. Similarly, in the study by Liu et al. (2022) in China, the highest overlap among different designations was found in Natural Reserves, which also had the largest surface area.

Instead, SN, which belong to local-scale designations, represented a smaller surface area (79,443,5 hectares) despite having a significant number of overlaps. Even the Private Conservation (CP) designation, which had the next highest number of overlaps, covered a smaller area than SN (7,816,3 hectares). This situation was described in the study by Deguignet et al. (2017, 5), where it was observed that, unlike Liu et al. (2022), units with smaller surface areas and multiple designations had a higher number of overlaps. Despite this difference, it can be deduced that there is a relationship between the amount of overlaps and the surface area covered by the protected units across different designations.

Table 4 below demonstrates the number of overlaps detected between designations, with a maximum of seven overlaps between Ecological Preservation Areas and Nature Sanctuaries, as well as between Priority Sites and Nature Sanctuaries. This is followed by Ecological Preservation Areas and Private Conservation, which have five overlaps. In the studies by Deguignet et al. (2017) and Liu et al. (2022), the number of overlaps per designation ranged from eight to five, respectively.

Scale	Designation protection	Total overlaps	%
Global	Biosphere Reserve (RB)	5	5,7
	Ramsar Site (SR)	1	1,1
	<b>Total</b>	<b>6</b>	<b>6,8</b>
National	Protected National Asset (BNP)	4	4,5
	Natural Monument (MN)	2	2,3
	National Park (PN)	2	2,3
	National Reserve (RN)	3	3,4
	<b>Total</b>	<b>11</b>	<b>12,5</b>
Regional	Ecological Preservation Area (APE)	21	23,9
	Priority Site (SP)	17	19,3
	<b>Total</b>	<b>38</b>	<b>43,2</b>
Local	Private Conservation (CP)	8	9,1
	Municipal Nature Reserve (RENAMU)	4	4,5
	Nature Sanctuary (SN)	17	19,3
	Conservation Landscape (PC)	4	4,5
	<b>Total</b>	<b>33</b>	<b>37,5</b>
	<b>Overall Total</b>	<b>88</b>	<b>100</b>

Table 3. Number of overlaps by protection designation, by scales of analysis.  
Source: Own elaboration (2023).

*Multiscale analysis in an overlap area: Nature Sanctuary “Cerro El Roble”*

Initially, the overlapping zone for conducting the multiscale governance analysis was defined based on the criterion of a surface area equal to or smaller than 1.000 hectares for the protected units. Using this criterion, 15 protected areas and other designations were selected, encompassing local, national, and global scales, with governance types ranging from private, government, to shared (see Appendix 2).

Upon identifying the number of overlaps among these protected units, it was observed that the highest number of overlaps occurred with the 1) “Cerro El Roble” Nature Sanctuary (SN), which overlaps with three other protected units: 2) “La Campana – Peñuelas” Biosphere Reserve (RB), 3) Ecological Preservation Area (APE) within the Santiago Metropolitan Regulatory Plan (PRMS), and 4) “El Roble” Priority Site (SP) (Table 5). Regarding the configuration of scales and governance types, these four overlapping units represent local, regional, and global analysis scales, combining government and shared governance types. This zone exhibits a mixed form of protection due to the involvement of different actors and regulations that vary across scales (Cárdenas, 2014).

At the global scale, the “La Campana-Peñuelas” Biosphere Reserve (RB) was designated in 1984 and expanded in 2009, spanning across the Valparaíso and Metropolitan regions. The Biosphere Reserve is a designation that identifies terrestrial or coastal/marine ecosystems recognized under the framework of the UNESCO Man and the Biosphere (MaB) Program. This program is governed by the “World Network of Biosphere Reserves” statute, which emphasizes the need to establish a core zone where official designations by the country are declared to ensure effective protection (Vivanco, 2019, 2). In Chile, the National Forest Corporation is the government entity responsible for the country’s engagement with the MaB program and the management of Biosphere Reserves (Corporación Nacional Forestal, n.d.).

At the regional scale, there are Ecological Preservation Areas (APE) and Priority Sites (SP) that, although not categorized as protected areas, provide protection effects when it comes to the siting of investment projects subject to environmental assessment procedures (Law 19300, 1994).

The Santiago Metropolitan Regulatory Plan is a mandatory territorial planning instrument of the Regional Government of the Metropolitan



Overlapping designations Presence (1+) / Absence (0)		Global		National				Regional			Local			
		RB	SR	BNP	MN	PN	RN	APE	SP	CP	RE	NA	SN	PC
<b>Global</b>	Biosphere Reserve (RB)	0	0	0	0	1	0	0	1	1	1	0	1	0
	Ramsar Site (SR)	0	0	0	0	0	1	0	0	0	0	0	0	0
<b>National</b>	Protected National Asset (BNP)	0	0	0	0	0	0	0	1	2	0	1	0	0
	Natural Monument (MN)	0	0	0	0	0	0	0	1	1	0	0	0	0
	National Park (PN)	1	0	0	0	0	0	0	1	0	0	0	0	0
	National Reserve (RN)	0	1	0	0	0	0	0	0	1	0	0	0	1
<b>Regional</b>	Ecological Preservation Area (APE)	1	0	1	1	1	0	0	0	3	5	2	7	0
	Priority Site (SP)	1	0	2	1	0	1	0	3	0	1	0	7	1
	Private Conservation (CP)	1	0	0	0	0	0	0	5	1	0	1	0	0
<b>Local</b>	Municipal Nature Reserve (RENAMU)	0	0	1	0	0	0	0	2	0	1	0	0	0
	Nature Sanctuaries (SN)	1	0	0	0	0	0	0	7	7	0	0	0	2
	Conservation Landscape (PC)	0	0	0	0	0	1	0	0	1	0	0	0	0
<b>Total</b>	<b>5</b>	<b>1</b>	<b>4</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>21</b>	<b>17</b>	<b>8</b>	<b>4</b>	<b>17</b>	<b>4</b>	<b>17</b>	<b>4</b>

Table 4. Matrix of overlaps by protection designation, by scale of analysis.  
Source: Own elaboration based on Liu et al. (2022).

Region of Santiago (Resolution 20, 1994). Within the zonings for areas of natural value, the Ecological Preservation Area was established to safeguard these areas, based on the definition provided by the Metropolitan Regional Housing Ministry and Urban Development. Recently, its biodiversity value was reaffirmed, highlighting its legal strength as officially protected areas, and thus, any investment projects situated within them must undergo environmental assessment procedures (Dictamen E39766, 2020).

On the other hand, the Regional Biodiversity Conservation Strategy is a clear instrument that defines priority sites. The last update in 2013 was carried out by the Regional Government of the Metropolitan Region and the Metropolitan Regional Environment Ministry (Gobierno Regional Metropolitano de Santiago - Secretaría Regional Ministerial del Medio Ambiente Región Metropolitana de Santiago [GORE RMS - SEREMI MMA RMS], 2013). The “El Roble” Priority Site contains significant biodiversity, and due to its coinciding delimitation with the Ecological Preservation Area of the Santiago Metropolitan Regulatory Plan, maintains the legal status of an officially protected area under the environmental assessment system (Comisión Nacional del Medio Ambiente Metropolitana de Santiago, 2004, 47).

At the local scale, the “Cerro El Roble” Nature Sanctuary (SN) was established in 1967 and is located in the Caleu locality of Tiltil commune in the Metropolitan Region. This SN is owned by the “Asociación Comunal de Miembros Capilla de Caleu” [Association of Communal Members of Capilla de Caleu], which is a non-profit private territorial corporation. The administration of the sanctuary was delegated to the Sanctuary Administrative Commission, composed of four members from the corporation (Santuario de la Naturaleza Cerro El Roble, 2018). The establishment and management of sanctuaries can come from both the private and government sectors, but for official declaration, technical evaluation by government agencies such as the Council of National Monuments, the Ministry of the Environment, and the Council of Ministries for Sustainability is required. Once declared, they are supervised by the Environment Ministry. Therefore, these protected areas tend to have shared governance, requiring public-private coordination (Correa, 2016).

The spatial overlapping area is represented in Figure 2. Next, the duplications and synergies found through the multiscale governance

analysis of protected areas will be presented.

*Duplicity in the functions of multiple government actors*

Initially, a duplication of functions was detected among multiple government actors involved in the administration and declaration of protected areas, such as the National Forest Corporation, Santiago Regional Government, Environment Ministry, or Housing Ministry and Urban Development. These actors generally have different responsibilities, including promoting productivity, territorial planning, or biodiversity protection, which can lead to inconsistency and uncertainty regarding which entity is responsible for conservation functions within the government (Precht et al., 2016). Moreover, there is often a lack of integration and communication among officials from different sectoral organizations or even within the management of a single public agency, thereby undermining conservation efforts (Contreras et al., 2015). Recognizing the existing dispersion of capacities and lack of coordination in protected area management by the public or government sector (Sierralta et al., 2011), the overlapping designations of government protection in the case of the Cerro El Roble Nature Sanctuary can create a complex scenario for actor coordination.

*Duplicity in the legal force of protected areas and other designations*

Similarly, another duplication was detected regarding the rule system among these four protected areas, as the Nature Sanctuary alone is enough to achieve a high level of legal protection, given its recognition in the IUCN management categories and in the environmental impact assessment system for investment projects. While Schutz (2018) considered Nature Sanctuaries to be in a third place in terms of the legal level of protection, for the case under review, the “Cerro El Roble” Nature Sanctuary would be the area with the greatest legal effect, without the need for other designations to enhance protection. Even Reserves of the Biosphere would be in a fourth place, referred to as “other protection initiatives”, without legal recognition, regulation, or guaranteed permanence (Schutz, 2018, 4), as they require the designation of other designations to exercise legal protection.

Protection designation	Scale	Governance type
“La Campana – Peñuelas” Biosphere Reserve (RB)	Global	Government
Ecological Preservation Area (APE) of the Santiago Metropolitan Regulatory Plan (PRMS)	Regional	Government
“El Roble” Priority Site (SP)	Regional	Government
“Cerro El Roble” Nature Sanctuary (SN)	Local	Shared

Table 5. Overlap governance types, scale, and designation to Nature Sanctuary (SN) “Cerro El Roble”. Source: Own elaboration based on Correa (2016).

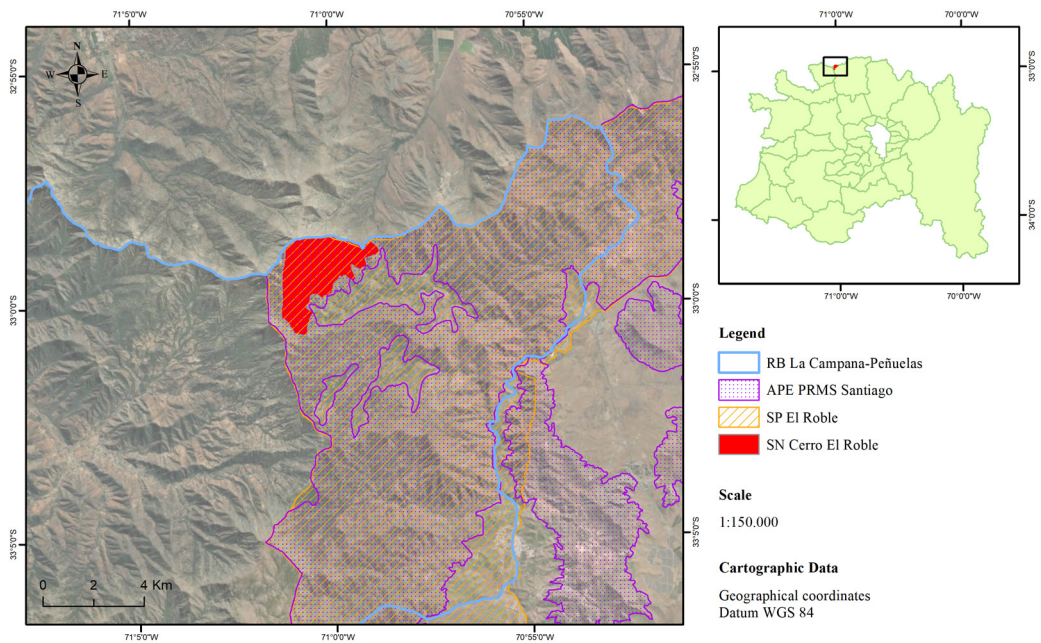


Figure 2. Overlap zone: SN Cerro El Roble.  
Source: Own elaboration (2023).

The Priority Sites and Ecological Preservation Area contribute with mandatory rules, which coincide with the recognition of official protection under the environmental impact assessment system (Dictamen E39766, 2020). These protected areas generate repetitive legal force in relation to the Nature Sanctuary, without an “accumulative” effect of protection. Therefore, the overlap between them would be more of a duplication than a contribution to enhancing protection.

*Synergies in the recognition of natural heritage relevance*

Despite this situation, the overlap of these four designations showed synergies in terms of recognizing the area as significant for natural heritage. In this sense, the presence of global, regional, and local designations in the same location provides visibility and positioning both in the Metropolitan region and internationally through organizations such as UNESCO, which can facilitate resource exchange such as political support or research (Borrini-Feyerabend et al., 2014). For example, in the update of the Regional Biodiversity Strategy (2013), the “El Roble” Priority Site is highlighted as one of the prioritized sites with a higher number of scientific publications, mainly addressing the “Cerro El Roble” Nature Sanctuary (GORE RMS - SEREMI MMA RMS, 2013, 70). Similarly, in the face of threats such as the forest fires that occurred in “Cerro El Roble” in October 2021, the recognition as a Biosphere Reserve allowed for mobilization and dissemination of its importance

by local stakeholders, including the mayor of Tiltil Municipality, who affirmed in a news report: “El daño medioambiental que causó este incendio, no solo en nuestra comuna sino también a la región Metropolitana es inmensa, el cerro El Roble es santuario de la naturaleza y amortiguación ecológica para el cerro La Campana, que es un pulmón verde, declarado por la Unesco, por lo que es indispensable para nuestra biósfera” [The environmental damage caused by this fire, not only in our commune but also in the Metropolitan region, is huge. Cerro El Roble is a nature sanctuary and an ecological for Cerro La Campana, which is a green lung declared by UNESCO, making it indispensable for our biosphere] (Crónica Digital, 2021).

This synergy of visibility is consistent with the ecological significance of “Cerro El Roble” Nature Sanctuary, which contains areas of the Santiago deciduous forest, an ecosystem that is sparsely represented in the state’s protected areas system (Comisión Nacional del Medio Ambiente Metropolitana de Santiago, 2004, 31). Thus, there is synergy through the appropriate definition of an overlap zone in unique and priority ecosystems, making it a successful case of protection addressing issues of representativeness and the lack of containment for key biodiversity by government designations (Schutz, 2018; Urbina-Casanova et al., 2016).

*Synergies or duplicities in shared governance for protection*

Shared governance between the private area

and Government in this overlapping zone can be seen as a synergy because, in this case, the Association of communal members of Capilla de Caleu (a private entity) demonstrated the willingness and the organizational capacity of its members to allocate part of their land tenure for protection, not only at the local level but also to contribute to government designations at the regional and global scales, such as the Priority Site or the Biosphere Reserve.

The diversity of private actors and/or local communities in the governance of protected areas helps to address the shortcomings or limitations of the public or governmental sector in terms of protection, especially when the land corresponds to private property (Jorquera-Jaramillo et al., 2012). This situation can be understood as a designation based on values, meanings, and management at a scale closer to natural heritage, which can be translated into more relevant and concise protection in the ecological, social, and economic context (Ayivor et al., 2020; Meffe et al., 2002).

However, this overlapping area can also result in harmful duplication in protection. The multitude of actors from different governance types increases the possibility of disarticulation and, consequently, issues arising around the same spatial area. Documented cases have shown that government involvement with private and/or local organizations in managing protected areas also leads to conflicts where local actors are harmed, excluded, and even dispossessed of their territory, prevailing an absence of dialogue in the selection of priority areas and the operational design of conservation units (Monteiro & Trombini, 2022).

For the case of the Cerro El Roble Nature Sanctuary, difficulties in the effectiveness of protective measures can be observed due to prevailing threats associated with the lack of regulation and control over visitors entering the area, for instance, the likelihood of new fires occurring. Currently, this protected area is closed to the public, depriving neighboring communities and other visitors who used to enjoy this place (Ladera Sur, 2023).

In shared governance of protected areas, attention must be paid to the imposition of actors at global, national, or regional scales over the local level, as it may deprive local communities of access to and use of the natural heritage and biodiversity contained within the protected area (Hoole, 2014).

For this reason, it is crucial that shared governance of protected areas be based on coordination and collaboration to avoid conflicts among local actors, adjacent communities, and local government administration (Rivera & Vallejos-Romero, 2015).

#### 4. Conclusion

Protected areas and other designations in central Chile showed significant overlap, with 90% of the 40 spatial units overlapping with

another protected area. The extent of overlap is likely directly related to the size of these areas, as larger areas had up to seven overlaps with smaller areas. These results were similar in studies of protected areas overlap conducted in other parts of the world, demonstrating that overlap is a common phenomenon when there are protection initiatives at different scales.

When examining the protection designations corresponding to the four scales analyzed in central Chile, different combinations were detected within the same spatial unit, resulting in mixed forms of protection where governance types, formal rule systems, and other efforts alternated. In this sense, the perspective of multiscale governance allowed the identification of the involvement of government and private actors in protection based on available regulations and voluntary initiatives, aiming to explore synergies and/or duplications in overlap situations.

The overlap in the study area was concentrated in regional designations linked to territorial planning (Ecological Preservation Area and Priority Sites), which served as a "protective umbrella" due to their large spatial extents and the legal force attributed to their recognition in the country's environmental assessment system.

The focus on areas smaller than 1.000 hectares facilitated an in-depth exploration of an overlapping zone where protection efforts are designated from the global to the regional and local scales. The Nature Sanctuary "Cerro El Roble", with three overlapping protections, was an example where synergies and duplications were distinguished within the framework of multiscale governance.

As duplications emerged: 1) redundant protection functions distributed across government sectors, which are established at different scales and maintain other types of faculties linked to productive development; 2) the rule system does not generate cumulative protection effects when overlapping designations occur, where all contribute as "under official protection". On the other hand, as synergy was identified: 3) the combination of global, regional, and/or local designations provides visibility on the importance of protecting the area.

A relevant finding was shared governance in this area of overlap, which can be seen as synergy and duplicity. The participation of local private actors alongside government actors at a regional and global scale defines a governance type that contributes to private land tenure and formal government rules to strengthen protection. However, this same configuration of scales and governance types can lead to imbalances in decision-making regarding the management of protected areas. Literature suggests that local communities and private entities are rather harmed, being excluded or even expelled from territories where the protection of natural heritage occurs.

Further research is needed to deepen our understanding of the effectiveness of protection through these legal and non-formal

mechanisms applied in protection, which can be explored in future investigations on overlap and natural heritage protection. Additionally, it is recommended to expand the research line with qualitative social research techniques in specific cases of overlap and protected areas to generate relevant proposals that enhance the described synergies and address duplications within the current protected areas system.

In order to formulate an institution that leads protection, as is the case in Chile, it is crucial to seek mixed forms of regulation with government regulations and contributions from the private sector and communities. Overlapping can be intentional to produce synergies, both in existing protection and in areas to be declared in the future, as long as there is a purpose to align efforts and interests between scales and types of governance to strengthen protection.

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**Appendices**

Appendix 1. Table of attributes used in ARCGIS 10.8 processing considering the protected area units and other designations belonging to the study area.

N	Name	Designation	Scale	Type governance	Municipality	Region	Area (hectares)
1	La Campana - Penuelas	Biosphere Reserve	Global	Government	Casablanca, Olmue, Quilpue, Tiltit	Region Valparaíso	238.216,0
2	Humedal El Yali (SR)	Ramsar Site	Global	Government	Santo Domingo	Region Valparaíso	520,0
3	Rio Olivares	Protected National Asset	National	Government	San Jose de Maipo	Region Metropolitana de Santiago	30.400,0
4	Laguna Cartagena	Protected National Asset	National	Government	Cartagena	Region Valparaíso	7,3
5	El Morado (MN)	Natural Monument	National	Government	San Jose de Maipo	Region Metropolitana de Santiago	3.009,0
6	La Campana	National Park	National	Government	Olmue, Limache	Region Valparaíso	8.000,0
7	Rio Clarillo	National Park	National	Government	Pirque	Region Metropolitana de Santiago	10.185,0
8	El Yali (RN)	National Reserve	National	Government	Santo Domingo	Region Valparaíso	520,4
9	Roblería del Cobre de Loncha	National Reserve	National	Government	Alhue	Region Metropolitana de Santiago	5.870,0
10	Plan Regulador Metropolitano Santiago	Ecological Preservation Area	Regional	Government	Colina, Lampa, Lo Barnechea, Maipo, Pirque, San Bernardo, San Jose de Maipo, Tiltit, Varias	Region Metropolitana de Santiago	7.372.400,0
11	El Roble	Priority Site (Law 19.300 Art 11, letra d)	Regional	Government	Curacavi, Lampa, Maipo, Padre Hurtado, Pudahuel, Tiltit	Region Metropolitana de Santiago	88.513,6
12	Cordon Cantillana	Priority Site (Law 19.300 Art 11, letra d)	Regional	Government	Alhue, Isla de Maipo, Melipilla, Paine, San Pedro	Region Metropolitana de Santiago	205.364,1
13	Rio Olivares, Rio Colorado, Tupungato	Priority Site (Law 19.300 Art 11, letra d)	Regional	Government	San Jose de Maipo	Region Metropolitana de Santiago	110.430,1
14	Altos del Rio Maipo	Priority Site (Law 19.300 Art 11, letra d)	Regional	Government	San Jose de Maipo	Region Metropolitana de Santiago	126.613,4



N	Name	Designation	Scale	Type governance	Municipality	Region	Area (hectares)
15	El Morado (SP)	Priority Site (Law 19.300 Art 11, letra d)	Regional	Government	Pirque, San Jose de Maipo	Region Metropolitana de Santiago	141.817,5
16	Parque Natural Cantalao	Conservacion Privada	Local	Private	La Reina, Peñalolen	Region Metropolitana de Santiago	330,3
17	Parque Cerro Viejo	Conservacion Privada	Local	Private	Quilpue	Region Metropolitana de Santiago	800,0
18	Parque Natural Aguas de Ramon	Conservacion Privada	Local	Private	Las Condes, La Reina, Lo Barnechea, Peñalolen	Region Metropolitana de Santiago	3.655,8
19	Predio Palmar de Lillahue	Conservacion Privada	Local	Private	Melipilla, San Pedro	Region Metropolitana de Santiago	500,0
20	Parque Puente Ñihue	Conservacion Privada	Local	Private	Las Condes, Lo Barnechea	Region Metropolitana de Santiago	990,6
21	San Carlos de Apoquindo	Conservacion Privada	Local	Private	Las Condes, Lo Barnechea	Region Metropolitana de Santiago	1.042,8
22	Quebrada Macul (CP)	Conservacion Privada	Local	Private	Las Condes, La Florida, Peñalolen	Region Metropolitana de Santiago	496,8
23	Humedal de Cartagena	Municipal Nature Reserve	Local	Government	Cartagena	Region Valparaiso	6,0
24	Mawida	Municipal Nature Reserve	Local	Government	La Reina	Region Metropolitana de Santiago	110,0
25	Quebrada Macul (RE-NAMU)	Municipal Nature Reserve	Local	Government	Peñalolen	Region Metropolitana de Santiago	S.i.
26	El Ajial	Nature Sanctuary	Local	Shared	Paine	Region Metropolitana de Santiago	2.134,0
27	San Francisco de Lagunilla y Quillayal	Nature Sanctuary	Local	Shared	San Jose de Maipo	Region Metropolitana de Santiago	13.426,0
28	Predio Los Nogales	Nature Sanctuary	Local	Shared	Lo Barnechea	Region Metropolitana de Santiago	11.025,0
29	Sector del Cerro El Roble	Nature Sanctuary	Local	Shared	Tiltill	Region Metropolitana de Santiago	996,1
30	Predio Altos de Cantillana, H. P. y R. C. L.	Nature Sanctuary	Local	Shared	Alhue, Melipilla, Paine	Region Metropolitana de Santiago	2.743,0
31	Predio Cascada de las Animas	Nature Sanctuary	Local	Shared	San Jose de Maipo	Region Metropolitana de Santiago	3.600,0

N	Name	Designation	Scale	Type governance	Municipality	Region	Area (hectares)
32	Las Torcasas de Pirque	Nature Sanctuary	Local	Shared	Pirque	Region Metropolitana de Santiago	827,0
33	San Juan de Piche	Nature Sanctuary	Local	Shared	Alhue, Melipilla	Region Metropolitana de Santiago	1.613,7
34	Quebrada de la Plata	Nature Sanctuary	Local	Shared	Maipu	Region Metropolitana de Santiago	1.110,7
35	Fundo Yerba Loca	Nature Sanctuary	Local	Shared	Lo Barnechea	Region Metropolitana de Santiago	39.029,0
36	Humedal Rio Maipo	Nature Sanctuary	Local	Shared	Santo Domingo	Region Valparaiso	60,0
37	Laguna de Batuco	Nature Sanctuary	Local	Shared	Lampa	Region Metropolitana de Santiago	274,0
38	Humedal de Tunquen	Nature Sanctuary	Local	Shared	Casablanca	Region Valparaiso	637,0
39	Horcon de Piedra	Nature Sanctuary	Local	Shared	Paine, Melipilla	Region Metropolitana de Santiago	1.968,0
40	Alhue	Landscape Conservation	Local	Shared	Alhue	Region Metropolitana de Santiago	84.500,0

Appendix 2. Protected area units and other designations with a surface area of less than 1.000 hectares.

Name	Designation	Scale	Type Governance	Area (hectares)	N° Overlaps
<b>Parque Natural Cantalao</b>	Private Conservation	Local	Private	330,3	1
<b>Parque Cerro Viejo</b>	Private Conservation	Local	Private	800,0	1
<b>Predio Palmar de Lillahue</b>	Private Conservation	Local	Private	500,0	1
<b>Parque Puente Ñilhue</b>	Private Conservation	Local	Private	990,6	1
<b>Quebrada Macul (CP)</b>	Private Conservation	Local	Private	496,8	2
<b>Humedal de Cartagena</b>	Municipal Nature Reserve	Local	Government	6,0	1
<b>Mawida</b>	Municipal Nature Reserve	Local	Government	110,0	1
<b>Sector del Cerro El Roble</b>	Nature Sanctuary	Local	Shared	996,1	3
<b>Las Torcasas de Pirque</b>	Nature Sanctuary	Local	Shared	827,0	1
<b>Humedal Rio Maipo</b>	Nature Sanctuary	Local	Shared	60,0	0
<b>Laguna de Batuco</b>	Nature Sanctuary	Local	Shared	274,0	0
<b>Humedal de Tunquen</b>	Nature Sanctuary	Local	Shared	637,0	0
<b>El Yali (RN)</b>	National Reserve	National	Government	520,4	1
<b>Laguna Cartagena</b>	Protected National Asset	National	Government	7,3	1
<b>Humedal El Yali (SR)</b>	Ramsar Site	Global	Government	520,0	1

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