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CLIMATE ACTION

NATURE-BASED SOLUTIONS: Opportunities in northern Chile

ACKNOWLEDGEMENTS

This work would not have been possible without the funding provided by the BHP Group. We hope that the information provided can encourage the implementation of new Nature-based Solutions in northern Chile, helping one of the most vulnerable countries to climate change to adapt and mitigate its impacts, while building resilience over time.

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This work aims to support in meeting BHP's climate change and social goals. It is also targeted to those who work in the biodiversity conservation area as well as investors and corporates who have a critical role to play in planning environment strategies and impact assessments.

BHP

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About Nature-based Solutions

Overexploitation of natural resources has not only damaged ecosystems but has also worsened the effects of **climate change**, leading to a range of detrimental consequences such as limited access to water or food, increased frequency of floods and droughts, loss of biodiversity, the emergence of heat islands, and a decline of ecosystem services.

A promising approach known as **Nature-based Solutions (NbS)** has emerged in response to these pressing environmental challenges. These solutions involve utilizing natural, semi-natural, or artificial ecosystems to implement measures for both **climate change mitigation and adaptation**. NbS is an umbrella concept, encompassing various projects and initiatives to address these issues. While the definition of NbS may vary depending on the source of information, these projects generally share the following characteristics:

- They utilize **sustainable practices** in nature to protect, manage, and restore a wide range of natural and semi-natural land and sea ecosystems.
- They can incorporate the assistance and **participation of local and indigenous communities** facing climate change challenges, such as biodiversity loss and natural disasters.
- They bring **several co-benefits**, such as mitigation and adaptation to climate change, enhancing cultural heritage, improving air and water quality, supporting ecotourism, etc.
- They aim to maximize potential **benefits to ecosystems**.
- They contribute to **sustainable development goals**, including poverty alleviation, food security, and human health and well-being.
- They are **cost-effective** and provide economic benefits, such as job creation and income generation.

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Chilean Law's definition of NbS

In Chile, the NbS concept was added in the Climate Change Framework Law (i.e. Law 21,455) as "Actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges such as climate change, food and water security or disaster risk, effectively and adaptively, while providing benefits for sustainable development and biodiversity"

Nature-based Solutions benefits

NbS can be related to several co-benefits, most of which are associated to the provision of ecosystem services. While some of these services are listed below distributed in three categories, it is worth noting that many benefits can fall under two or all three categories.

Benefits to nature

- Biodiversity protection
- Habitat quality for wildlife
- Erosion control
- Healthy soils
- Water supply
- Water purification
- Air purification
- Flood management
- Nutrient cycling

Social benefits

- Carbon capture and storage
- Water supply
- Water purification
- Air purification
- Flood management
- Food and drink supply
- Disease control
- Disaster risk reduction
- Space for recreation
- Spiritual and religious connections
- Inspiration
- Sense of place
- Natural medicines

Economic benefits

- Crop pollination
- Natural pest control
- Nutrient cycling
- Tourism
- Materials
- Renewable and non-renewable energy

What are the current trends in NbS?

Nature-based Solutions is a relatively new concept. Therefore, it is interesting to understand how its use **has increased over time** due to the **various ecosystem services** it can provide.

The volume of issued and retired credits from the voluntary carbon markets can be used as a proxy to estimate the **growth trend in the use of NbS**[1]. According to Climate Focus, emission reduction certificates retired from NbS projects have been **increasing significantly since 2010**. About 35 $MtCO_2e$ were retired in 2020, while in 2021 this number rose to 72 $MtCO_2e$ (Climate Focus, 2022) .

Furthermore, the **Science-Based Targets Initiative (SBTi)**, the most recognized initiative that establishes guidelines for setting emissions reduction targets, highlights the relevance of carbon capture measures in reaching carbon neutrality. Also, concerning offsetting emissions, SBTi states that "it is strongly recommended that companies prioritize interventions with **strong co-benefits** and that contribute to achieving **other social and environmental goals**" and that "companies with emissions that are not feasible for society to abate can resort to **nature-based carbon sequestration measures** to counterbalance the impact of unabated emissions" (SBTi, 2020). This background helps justify the growth in the demand for nature-based credits and suggests that the use of nature-based solutions will only continue increasing.

While funding towards mitigation projects has increased significantly, investment in adaptation measures is still low and has not seen much growth over time. Prices of carbon offsets generated by nature-based solutions have increased in the last years, and so has investment. These projects are linked to non-carbon benefits like income for communities and biodiversity protection, and thus are more valued by buyers.

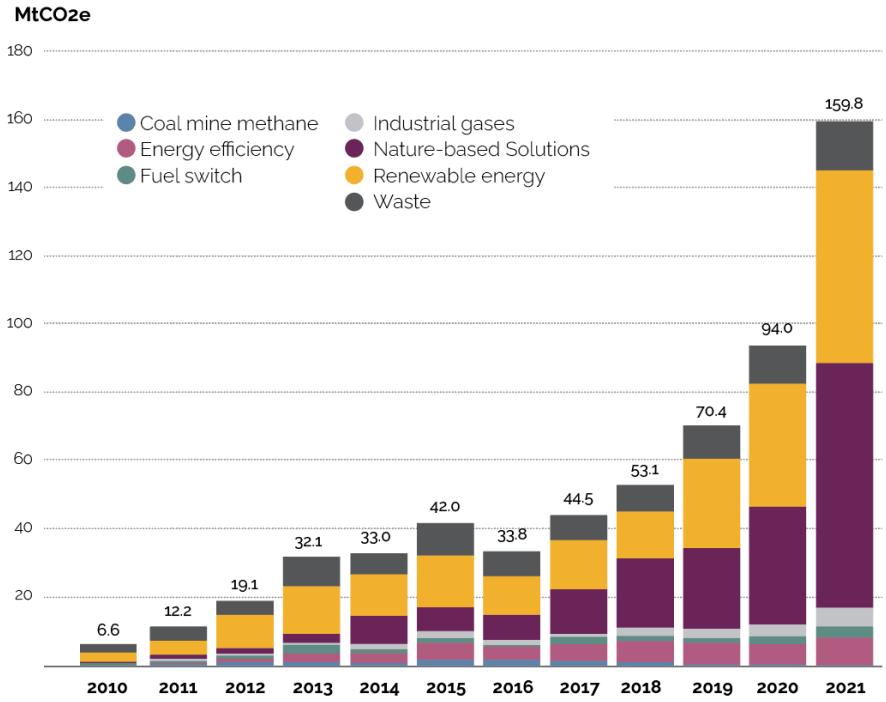


Figure 1: Trends of Nature-based Solutions and Renewable energy offsets in voluntary carbon markets
Source: Climate Focus, 2022

[1] Even though there are NbS initiatives that do not capture CO2, and thus cannot be registered as a carbon offset project for carbon markets

From sea to high-elevation Andean ecosystems

General context of the Tarapacá Region

The Tarapacá region, located within the Atacama Desert, covers an area of about 42,000 km² and had a population of around 330,500 inhabitants as of 2017. Its capital city, Iquique, is an important port coast. The region's primary economic activities revolve around mining and aquaculture, while other activities such as agriculture, animal husbandry, and tourism have a minor relevance.

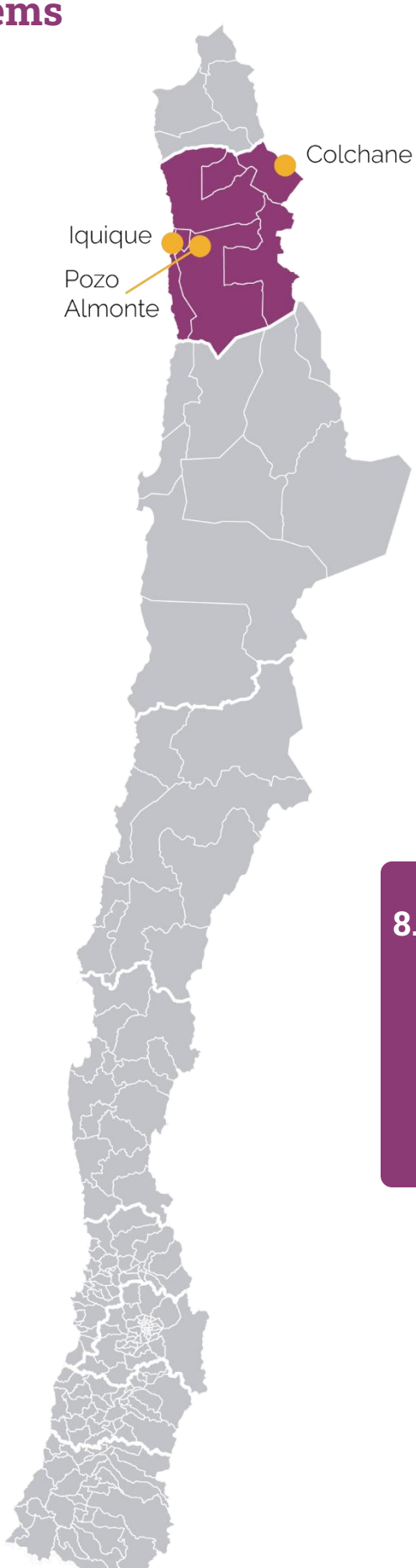
The most relevant climate threats projected for the region are an increase in average air temperature and a decrease in its already low annual precipitation, which could lead to a risk of biodiversity loss.

The region boasts a high density of protected areas with notable examples such as the National Park Volcan Isluga, National Park Salar del Huasco, National Reserve Pampa del Tamarugal, Nature Sanctuary Quebrada de Chacarilla, and the Playa Blanca urban wetland. One of these protected areas, Salar del Huasco, is recognized as a Ramsar site. Despite the number of protected areas, a relatively small surface has been designated by national authorities as *priority sites for conservation.*

In terms of endemic species, the Tarapacá region faces threats to its unique vegetation, particularly the tamarugo. This tree species is found from the Tana Creek to the Loa riverside and is considered threatened. The region also harbors endangered fauna species, including the Arica's hummingbird, *Centris moldenkei* (a type of bee), and the *Hippocamelus antisensis* (Taruka deer)

Lastly, it stands out for being a region with a high density of indigenous communities, many of which are Aymara communities that reside within the Jiwasa Oraje Indigenous Development Area, while others are Quechua communities.

Figure 2: Volcán Isluga National Park.
Source: Red Turismo Chile



General context of the Antofagasta Region

The Antofagasta region was home to 607,534 inhabitants as of 2017. It stands out for covering the largest area of land in continental Chile, totalling 126,049 km2, about 16.7% of the national territory. The region's capital is the city of Antofagasta.

The region boasts the highest GDP per capita in Chile, primarily due to its significant mining activity, with the Chuquicamata mine being the world's largest open pit mine. Tourism also plays a crucial role, especially in places like San Pedro de Atacama and the Salar de Atacama. Other important economic activities include aquaculture and energy production, both renewable and non-renewable. Notably, the region hosts most of Chile's desalination plants, catering to mining and human consumption needs in places like Tocopilla and Mejillones (Vicuña, 2022)

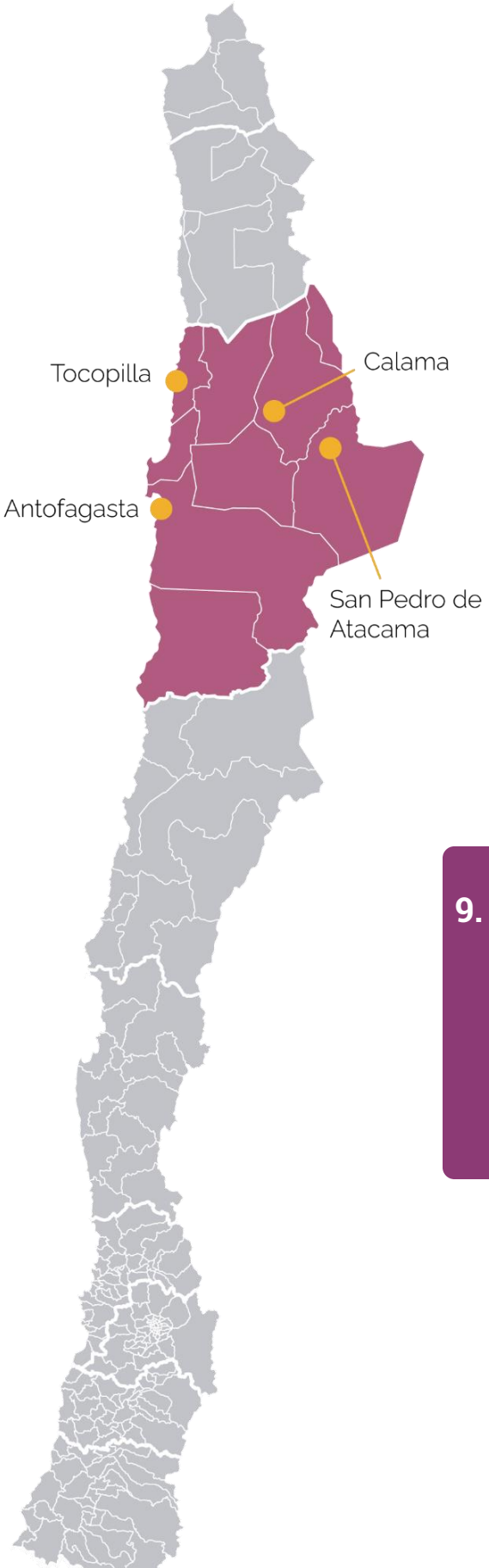
Regarding natural attractions, Antofagasta houses a Marine Reserve (Bahía Moreno – La Rinconada) and Natural Monuments (La Portada and Paposo Norte). Moreover, it boasts Ramsar sites, Natural Reserves, urban wetlands, Natural Sanctuaries, and National Parks.

The region's priority conservation sites are primarily found in coastal areas and high Andean ecosystems, such as the Geiser del Tatio and Salar de Atacama. The northern side of the region faces a higher risk of losing biodiversity due to climate threats.

Several endemic species including *Liolaemus torresi* (Torres-Mura's Dragon), *Liolaemus foxi*, *Liolaemus fabiani, Orestias ascotanensis* (Karachi), *Krameria cistoidea, Centris Tamarugalis and Helebia atacamensis* are currently classified as threatened. Along the coast, notable threatened species include the chungungo, green sea turtles and *Sternula superciliaris*

Lastly, Antofagasta is home to many indigenous communities, belonging to the Quechua and Atacameño territories which have organized themselves into Indigenous Development Areas such as Alto Loa and Atacama La Alta.

Figure 3: Salar de Atacama. Source: Diario Antofagasta



General context of the Atacama Region

The Atacama region lies between the Antofagasta and Coquimbo Regions. According to the 2017 Census, it has a population of 286,168 inhabitants and covers an area of 75,176 km2. The capital city of the region is Copiapó.

The region's main economic activities revolve around mining, aquaculture in coastal areas, and agriculture, particularly grape and olive cultivation along the Huasco and Copiapó rivers. It has a desalination plant which helps meet the water needs of the communes of Caldera, Chañaral and Tierra Amarilla. Additionally, the region attracts tourists due to the phenomenon of the "Desierto Florido", recently designated as a National Park.

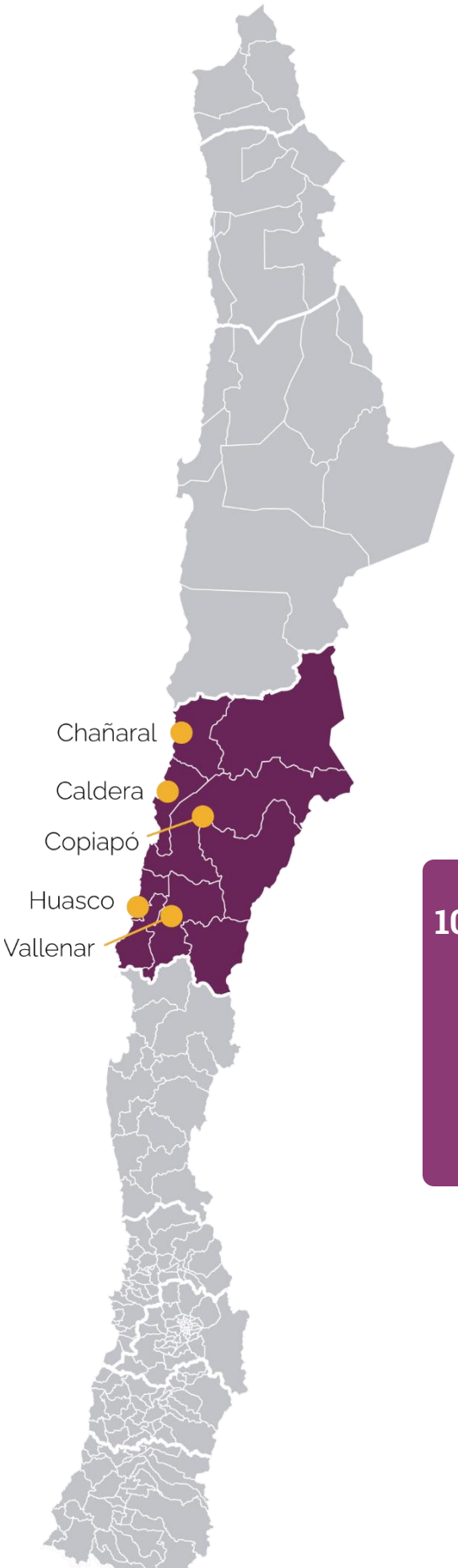
Atacama is home to the Marine reserves Punta Morro, Isla Chañaral, and Isla Choros-Damas. It also shares the Pan de Azúcar National Park with the Antofagasta Region, and it boasts other national parks like Nevado Tres Cruces, Llanos del Challe, Pingüino de Humboldt, and Desierto Florido.

The region contains several priority sites for conservation, with the largest surface being the flowering desert area, followed by coastal patches, salt flats, Andean lakes, and high Andean riverbeds. Chascos Bay has gained significant attention due to its ecological value, environmental risks, and the establishment of new megaprojects.

Numerous threatened endemic species can be observed in the region, including cacti species such as *Copiapoas*, insects such as *Caupolicana fulvicollis*, flowers such as *Conanthera urceolata,* reptiles such as *Liolaemus audivelatus, Diomedeidae* birds (Albatross), Humboldt penguins, Yunco ducks, and *Zostera chilensis* (seagrass).

Furthermore, the region has a substantial number of indigenous communities, mainly located in the Andean zone, particularly in the territories of Colla and Diaguita.

Figure 4: Pan de Azúcar National Park.
Source: ChileEsTuyo



Ecosystems addressed by Nature-based Solutions in northern Chile

While NbS can be developed in various types of ecosystems, this report focused on describing projects that could be developed under 5 ecosystems, in line with the work of the Chilean Scientific Committee for Climate Change. These ecosystems are:

- **Forests and xerophytic formations**: areas comprised mostly of trees and/or native species of shrubs, succulents, and cacti. Northern Chile is characterized by its arid climate, making xerophytic formations the predominant vegetation.
- **Agriculture**: natural and human-made components that interact and work together to support the cultivation of crops and livestock for food, fibre, and other products. In Northern Chile, crops are located mainly in the riverside of the main water courses due to water scarcity.
- **Wetlands**: water bodies found along river and stream corridors, in floodplains, near coastlines, in arid zones as salt lakes, and low-lying areas such as swamps and marshes. Northern Chile is home to a significant number of salt lakes and "bofedales," which are high altitude Andean wetlands featuring hydromorphic vegetation and peat.
- **Oceans and coastal zones**: dynamic and ecologically rich zones that support a wide range of organisms and habitats and are characterized by the interaction of terrestrial and marine processes. The northern Chilean coast is characterized by the presence of kelp forests and for supporting aquaculture and traditional fishing coves.
- **Cities**: ecosystems characterized by the interactions between different living and non-living components in urban areas. They include various elements such as natural resources, infrastructure, human communities, and wildlife. Mining activity in northern Chile has led to the establishment of human settlements and ports along the coast, and mining towns in the mountains and desert.

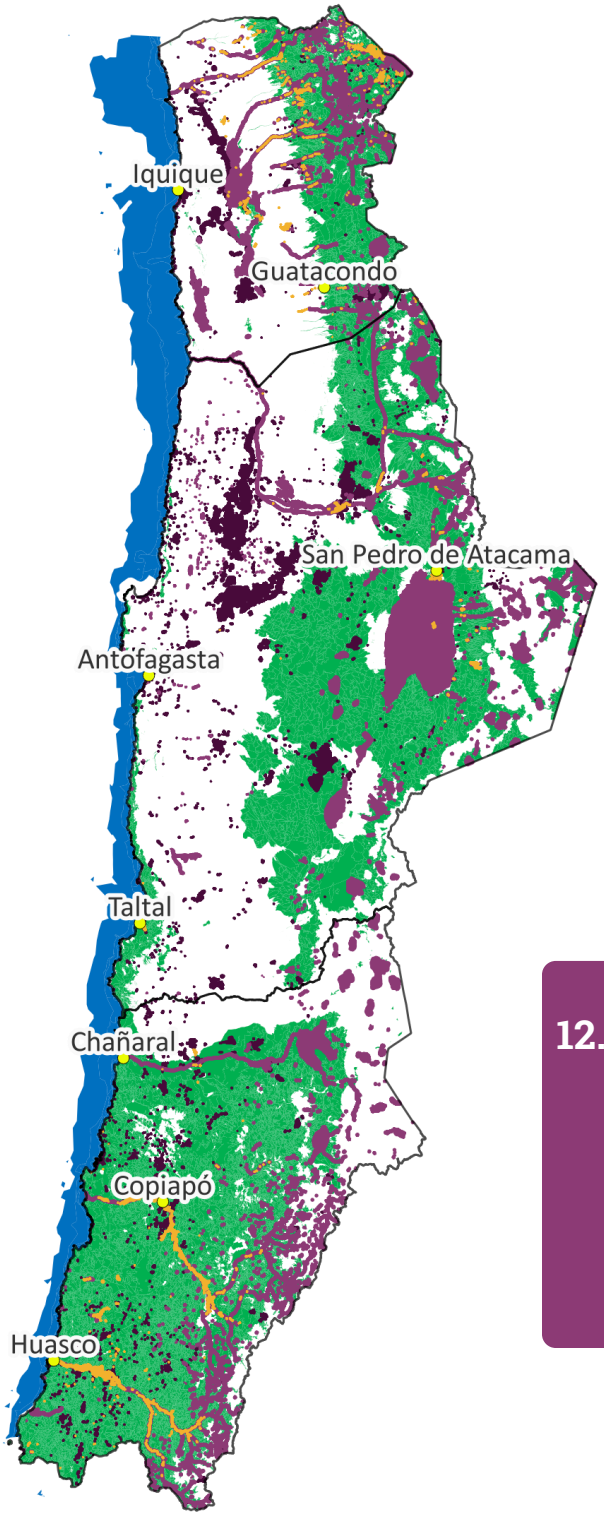
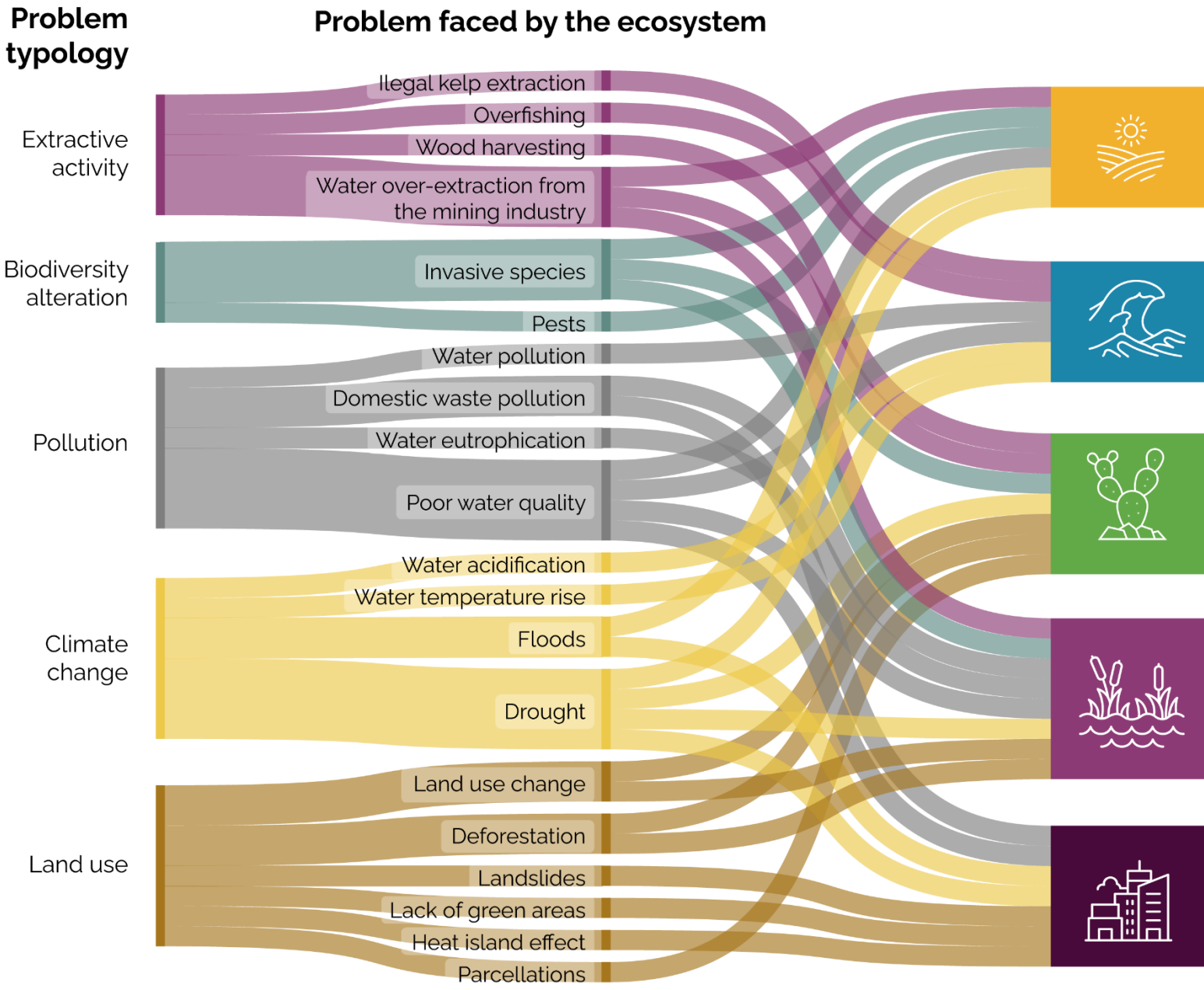


Figure 5: Ecosystem distribution by region
Source: ImplementaSur

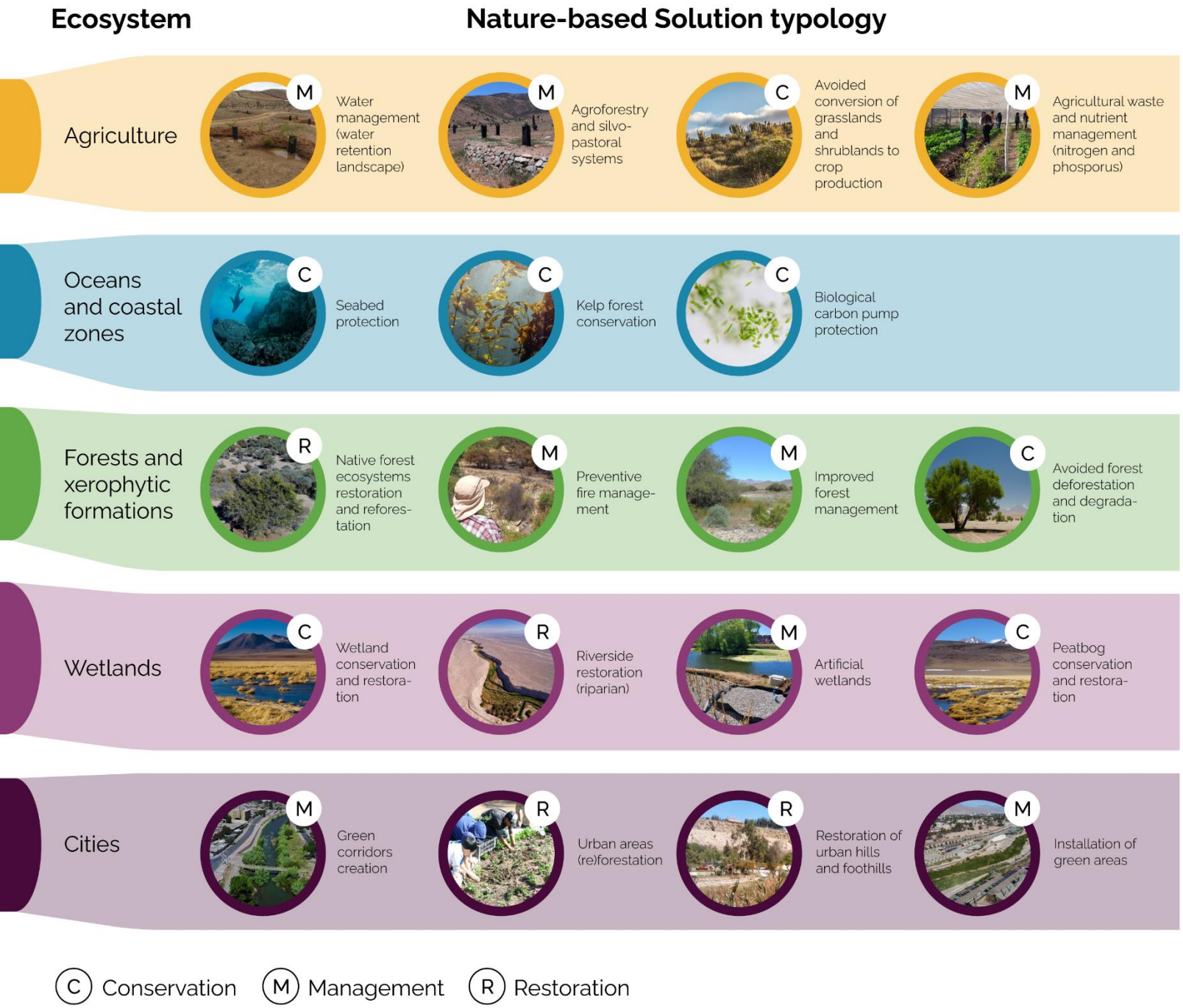
Nature-based typologies by type of ecosystem

The following diagram illustrates various problems faced by the five previously mentioned ecosystems, along with several nature-based solutions typologies that could address these problems.



Ecosystems of northern Chile face problems that can be directly or indirectly attributed to human activities, which have been traditionally solved by solutions that rely on engineered or constructed systems. In that sense, NbS seek to solve them by using sustainable practices that provide ecosystem services.

Some ecosystems such as cities or agriculture not only face threats but also have the ability to create hazards downstream to other ecosystems. Therefore, the nature-based solutions shown in the figure also aim to reduce the impacts of land uses towards biodiversity and communities.



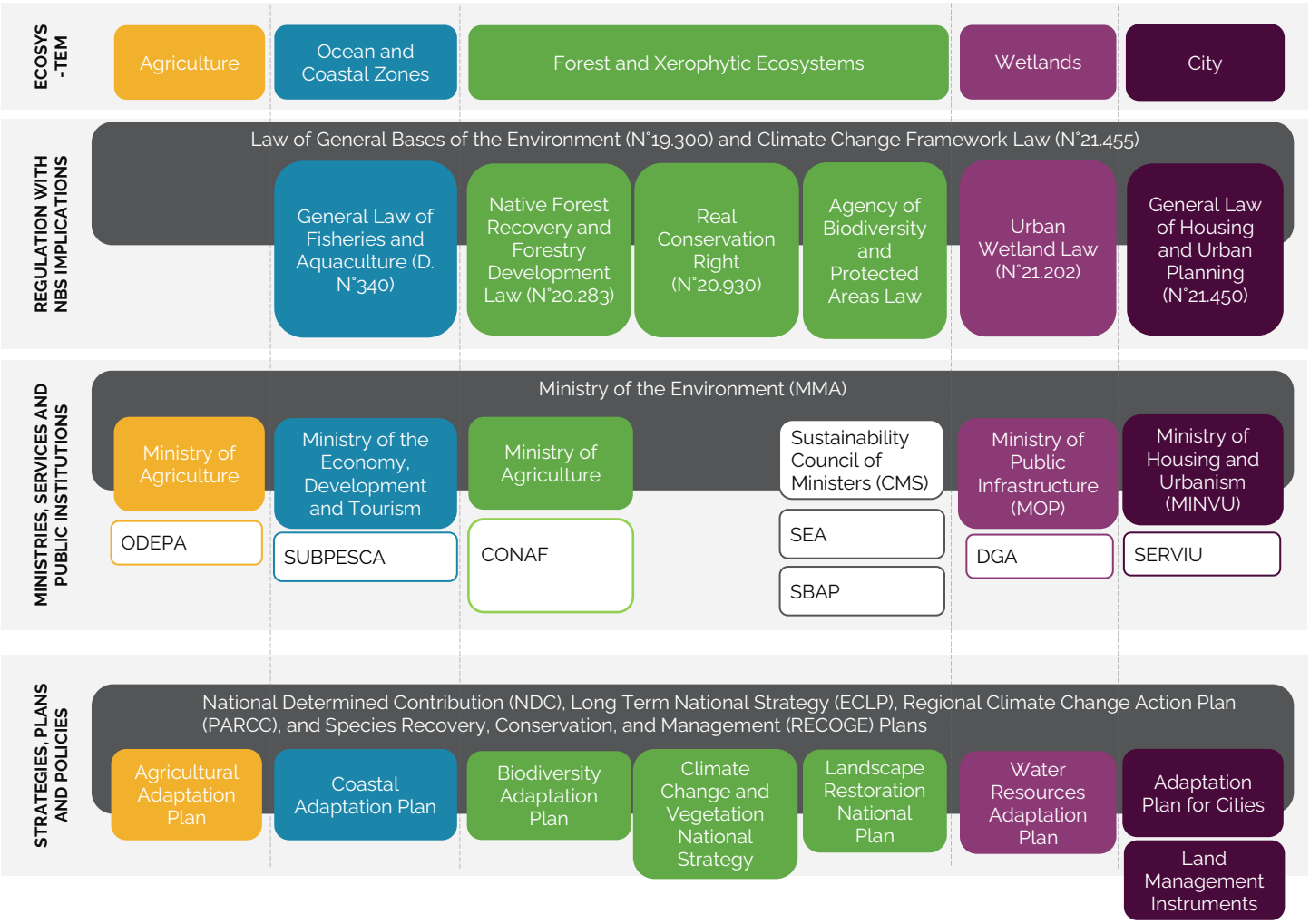
Picture sources: Ladera Sur, soychile, INFOR, ytimg, Wikimedia, Diario Concepción, Terram, Creatividad Positiva, CONAF, INDAP, Flickr, La Tercera, El Mostrador, Bioenciclopedia, & Tierramarillano.

Nature-based Solutions in Chile: Governance Scheme

In order to assist developers of NbS projects, the following map outlines the main governmental **actors**, **regulations**, and **policies** related to NbS in Chile. The information is arranged according to the five ecosystems discussed in the previous sections.

It is worth noting that Chile is a party of the United Nations Convention on Biological Diversity (CBD) which recently adopted the **Kunming-Montreal Global Biodiversity Framework (KGBF)** which sets new goals on biodiversity, including the promotion of Nature-based Solutions. Target N°8 specifically states the aim to "minimize the impact of climate change and ocean acidification on biodiversity and increase its resilience through mitigation, adaptation, and disaster risk reduction actions, **including through nature-based solution** and/or ecosystem-based approaches (…)".

Figure 6. Map of main governmental actors, regulations, and policies related to Nature-based Solutions by ecosystem.



Source: ImplementaSur

Developing Nature-based Solutions: Criteria, Barriers, and Enabling conditions

For a NbS project to be successful, it is important to create internal guidelines for its design, implementation, and monitoring, and make them public for fair assessment of results. The IUCN's Global Standard for NbS offers a set of guidelines consisting of **eight criteria** that a project should meet. These criteria ensure that the project is based on sound scientific principles, considers the needs of all stakeholders, is adaptable to changes, and has monitoring and evaluation systems to assess its impact.

Figure 7. Criteria for Ensuring Successful Development of Nature-based Solutions.

Source: Adapted from IUCN's Global Standards

In addition to the aforementioned criteria, developers of NbS projects should also be mindful of the potential **barriers and enabling conditions** that the project may encounter, which will allow them to develop a well-defined plan to address obstacles. Some barriers and enabling conditions are presented below.

Table 1. List of barriers and enabling conditions for the implementation of NbS projects.

Type	Barriers	Enabling conditions and success factors
Institutional	• Lack of engagement of stakeholders in co-design and monitoring. • Lack of a NbS local or sectoral governance scheme.	• Political support. • Alignment to governmental programs and policies.
Regulatory	• Permit granting. • Regulatory uncertainty (e.g., Regional Plans). • Acquisition of land (or concession to use it).	• Acceptance of compensation certificates as mechanisms to comply with new GHG emissions limits (Law 21.455) • Regulatory flexibility to allow wide applicability to funds that aim to regenerate/recover/protect xerophytic formations.
Social	• Multiple landowners. • Local community opposition. • General skepticism to NbS or lack of knowledge.	• Promotion of local communities' s engagement. • Indigenous knowledge related to nature protection.
Technical	• Climate threats and risks. • Lack of robust methodologies to quantify benefits of projects. • Lack of a global accounting system for monitoring, reporting, and verifying (MRV).	• Involvement of research institutions and/or external experts. • Deep knowledge of ecological cycles. • Use of available local technologies.
Economic	• High investment cost (acquisition of land and data collection). • Uncertainty of cost for some types of NbS. • Lack of incentives.	• Sufficient funding for feasibility and technical studies. • Sufficient funding for monitoring and data collection activities. • Combined revenue streams.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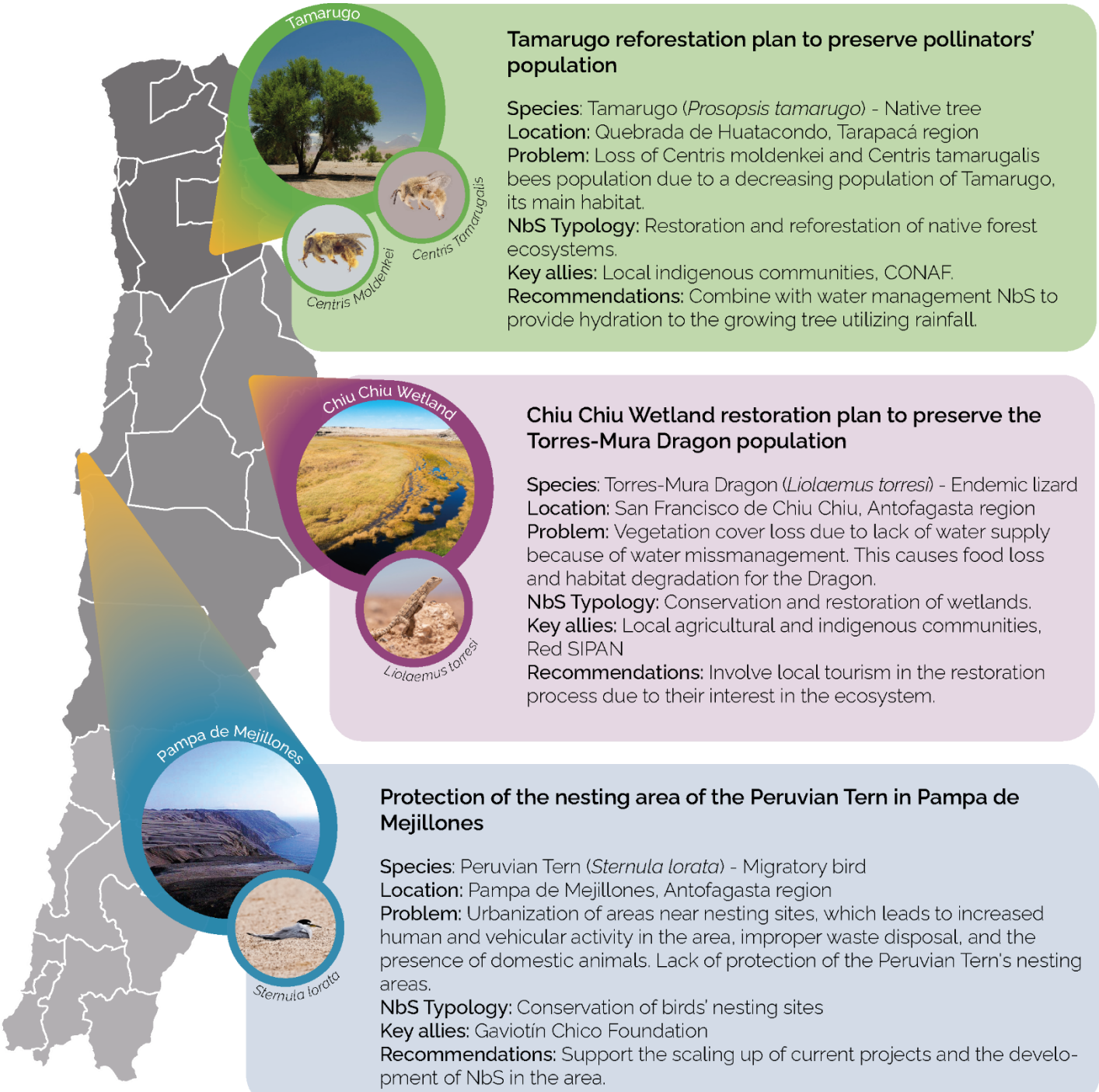
Exploring NbS Opportunities

Based on the characterization of ecosystems in northern Chile, numerous and diverse opportunities for NbS can be identified. The following maps describe in a more in-depth manner 7 opportunities, incorporating attributes such as the problem being addressed, the location of the solution, the project's typology, and key allies.



Tamarugo reforestation plan to preserve pollinators' population

Species: Tamarugo (*Prosopsis tamarugo*) - Native tree
Location: Quebrada de Huatacondo, Tarapacá region
Problem: Loss of Centris moldenkei and Centris tamarugalis bees population due to a decreasing population of Tamarugo, its main habitat.
NbS Typology: Restoration and reforestation of native forest ecosystems.
Key allies: Local indigenous communities, CONAF.
Recommendations: Combine with water management NbS to provide hydration to the growing tree utilizing rainfall.

Chiu Chiu Wetland restoration plan to preserve the Torres-Mura Dragon population

Species: Torres-Mura Dragon (*Liolaemus torresi*) - Endemic lizard
Location: San Francisco de Chiu Chiu, Antofagasta region
Problem: Vegetation cover loss due to lack of water supply because of water missmanagement. This causes food loss and habitat degradation for the Dragon.
NbS Typology: Conservation and restoration of wetlands.
Key allies: Local agricultural and indigenous communities, Red SIPAN
Recommendations: Involve local tourism in the restoration process due to their interest in the ecosystem.

Protection of the nesting area of the Peruvian Tern in Pampa de Mejillones

Species: Peruvian Tern (*Sternula lorata*) - Migratory bird
Location: Pampa de Mejillones, Antofagasta region
Problem: Urbanization of areas near nesting sites, which leads to increased human and vehicular activity in the area, improper waste disposal, and the presence of domestic animals. Lack of protection of the Peruvian Tern's nesting areas.
NbS Typology: Conservation of birds' nesting sites
Key allies: Gaviotín Chico Foundation
Recommendations: Support the scaling up of current projects and the development of NbS in the area.

Ecosystems Legend

- Agriculture
- Oceans and coastal zones
- Forest and xerophitic formations
- Wetlands
- Cities

Queñoa reforestation plan in Coska

Species: Queñoa (*Polylepsis tarapacana*) - Native high-altitude tree
Location: Mountains' and volcanoes' hillsides in Coska, Antofagasta region.
Problem: Severe deforestation due to land use change for livestock and mining activities, as well as for medicinal purposes and as fuel.
NbS Typology: Restoration and reforestation of native forest ecosystems.
Key allies: Local indigenous communities, CONAF (National Forestry Corporation)
Recommendations: Combine with water management NbS to provide hydration to the growing tree utilizing rainfall.

Conservation of the Carcote and Ascotán salt flats to preserve the population of the Karachi fish

Species: Karachi (*Orestias ascotanensis*) - Andean fish
Location: Carcote and Ascotán salt flats, Antofagasta region.
Problem: Decrease in water levels due to mining operations, contamination of water bodies, changes in aquatic vegetation, and introduction of salmonids.
NbS Typology: Conservation and restoration of wetlands.
Key allies: Local indigenous communities, El Abra mining company.
Recommendations: Promote research that facilitates the protection of the species.

Soncor conservation initiative to preserve Liolaemus fabiani's population

Species: Fabián Lizard (*Liolaemus fabiani*) - Endemic lizard
Location: Soncor hydrological system, Antofagasta region.
Problem: Habitat loss due to mining activity and unregulated tourism. Pressure from lithium mining.
NbS Typology: Conservation and restoration of wetlands.
Key allies: Communities of Toconao, Soncor, and Camar, MMA, SQM
Recommendations: Involving local tourism in the restoration process due to their interest in the ecosystem. Defining ecosystem protection criteria in the National Lithium Strategy.

Conservation of kelp forests and seagrass in Chascos Bay to protect green sea turtles

Species: Green Sea Turtle *(Chelonia mydas)*
Location: Chascos Bay, Atacama region.
Problem: Threat to the ecosystem due to the installation of the Andes LNG project (natural gas infrastructure) and Copiaport-E (general-use port).
NbS Typology: Conservation of kelp forests and seagrass reforestation and habitat restoration.
Key allies: Qarapara Foundation, local fishermen, and seaweed gatherers in the area.
Recommendations: Involving local fishermen and seaweed gatherers in the development of the conservation program. Supporting the designation of Chascos Bay as a Coastal Marine Protected Area.

Final Recommendations

Beyond considering the potential barriers and enabling conditions to which a project may be subject and the criteria it should meet, there are some other aspects that are worth looking into. The following list aims to provide additional recommendations to ensure the successful development of NbS projects.

I. Take into account considerations regarding the approach to local communities.

There is significant scepticism among local communities in northern Chile towards extractive companies. Engaging through a respected local spokesperson for initial dialogue is recommended. A flexible approach is also crucial, as communities may prioritize site-specific issues, providing valuable insights for effective communication and cooperation.

II. Conduct preliminary site-specific technical studies to assess the feasibility of the identified opportunities.

Site-specific studies on biodiversity, land ownership, and ecosystem services are vital for successful NbS projects. A dedicated technical team can assess feasibility, define indicators, and identify risks. Comprehensive studies could also unveil new NbS prospects, reinforcing their commitment to sustainability.

III. Mitigate reputational risks associated with greenwashing.

As the knowledge and adoption of NbS grow, so do associated controversies. To avoid greenwashing accusations, project developers must adhere to high standards and establish specific internal guidelines for NbS projects. These guidelines should be shared with the public and discussed with local communities. International organizations, like the IUCN, offer valuable principles for developing quality NbS projects.

IV. Develop long-term strategies that guarantee sufficient funding for monitoring and management.

Many companies lack a long-term strategy for sustainable restoration efforts, affecting community engagement. However, restoration opportunities can become scalable projects with ecosystem benefits through careful planning and collaboration. Project developers should co-design work plans and secure long-term funding with communities and authorities.

V. Utilize tools for assessing ecosystem services and tracking the success of NbS implementations.

Various tools like InVEST and ARIES can assess the environmental and economic benefits of ecosystem actions, but they usually use simplified models, lacking social and cultural dimensions. Such tools could help value challenging projects like kelp or seagrass reforestation, where carbon capture quantification methodologies have not yet been developed.

VI. Support applications and declarations for ECMPO.

ECMPOs are marine areas managed by indigenous communities to preserve their cultural, economic, and recreational practices. Communities apply to SUBPESCA for ECMPO creation, with 100 registered applications, including 2 in northern Chile. Assisting these communities in obtaining ECMPOs could foster long-term cooperation, potentially leading to new marine NbS opportunities.

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