Integrating Biodiversity Offsets into the Chilean EIA process

By

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Thesis submitted for the degree of Doctor of Philosophy

University of East Anglia
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November 2024

Abstract

Biodiversity offsetting is a conservation strategy aimed at compensating for unavoidable biodiversity losses resulting from development projects by creating equivalent biodiversity gains elsewhere, seeking to achieve 'no net loss' (NNL) or, ideally, 'biodiversity net gain' (BNG). Given the current biodiversity crisis and the critical role that biodiversity plays in sustaining ecosystems and human well-being, its protection has become a priority in global conservation efforts. This thesis investigates how Chile's Environmental Impact Assessment (EIA) System can help to achieve NNL of biodiversity, addressing critical gaps in policy and practice. Firstly, Chilean biodiversity offset practices are evaluated against international benchmarks to identify gaps in legislative frameworks and highlight areas where Chile could enhance its approach to biodiversity offsetting. 18 international best-practice principles for biodiversity offsets were identified, forming a global analytical framework for evaluating biodiversity offset policies. Secondly, using a pragmatist research approach, this research employs qualitative and quantitative methods, including semi-structured interviews, to investigate how Chile adheres to national environmental obligations concerning biodiversity. The main findings highlight that biodiversity offsetting faces challenges in Chile due to weak adherence to the mitigation hierarchy, limited practitioner expertise, monitoring uncertainties and ineffective reporting. Finally, using an integrated approach of focus group and interviews, the study explores specific opportunities for enhancing biodiversity outcomes through the EIA System in Chile. These evidence-based recommendations include adaptive management, strengthened accountability, and use of ecosystem-based approaches as a means of improving biodiversity conservation outcomes and guide policy reforms. Additionally, the research contributes to the literature on environmental governance and biodiversity offsetting by proposing specific recommendations for enhancing the effectiveness of biodiversity measures, and by developing an analytical framework for evaluating biodiversity offset policy. Ultimately, the research bridges theory and practice to support more sustainable and transparent environmental decision-making processes in Chile, influencing both national regulation and global biodiversity conservation efforts.

Table of Contents

List of figures

List of tables

List of Abbreviations

BBOP: Business and Biodiversity Offsets Programme

BNG: Biodiversity Net Gain

CBD: Convention on Biological Diversity

CIEEM: Chartered Institute of Ecology and Environmental Management

CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora

CLT: Chilean Standard Time

CONAF: Corporación Nacional Forestal (Chile) [*National Forest Corporation*]

COP: Conference of Parties (on Biological Diversity)

ECLAC: Economic Commission for Latin America and the Caribbean

EIA: Environmental Impact Assessment

EIAS: Environmental Impact Assessment System

EIASR: Environmental Impact Assessment System Regulation

EID: Environmental Impact Declaration

EIS: Environmental Impact Study

ESRC: Economic and Social Research Council

FPIC: Free and Prior Informed Consent

GIBOP: The Global Inventory on Biodiversity Offset Policies

GT: Grounded Theory

IFC: International Finance Corporation

IPBES: Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services

IPCC: Intergovernmental Panel on Climate Change

IUCN: International Union for Conservation of Nature

KMGBF: Kunming-Montreal Global Biodiversity Framework

MINSEGPRES: Ministerio Secretaría General de la Presidencia (Chile) [*Ministry General Secretariat of the Presidency*]

MMA: Ministerio de Medio Ambiente (Chile) [*Ministry of Environment*]

NEPA: National Environmental Policy Act

NGO: Non-Governmental Organization

NNL: No Net Loss

RCA: Resolución de Calificación Ambiental (Chile) [*Resolution of Environmental Qualification*]

SAG: Servicio Agrícola y Ganadero (Chile) [*Agricultural and Livestock Service*]

SEA: Servicio de Evaluación Ambiental (Chile) [*Environmental Assessment Service*]

SEIA: Sistema de Evaluación de Impacto Ambiental (Chile) [*Environmental Impact Assessment System*]

SMA: Superintendencia de Medio Ambiente (Chile) [*Superintendency of the Environment*]

TBC: The Biodiversity Consultancy

UEA: University of East Anglia

UK: United Kingdom

UNDP: United Nations Development Programme

UREC: University Research Ethics Committee

US: United States

WBG: World Bank Group

Acknowledgements

I am sincerely and deeply grateful to my supervisors Dr. Alan Bond and Dr. Aldina Franco for accepting me as their student. Thank you for giving me the opportunity to do my PhD with you, for your guidance, advice and support. Honestly, I could not have asked for better supervisors. It has been a privilege to work with you both.

To my dearest husband Mario, I am endlessly grateful for his love and support throughout all these years. But above all, for his patience. His kindness and companionship mean everything to me. I would not have made it here without you. Love you always.

To my family and friends in Chile, for their support when I decided to do my PhD and for being with me no matter the distance, always supporting me and cheering me up.

To my Norwich family, Paola y Michael, who have become an indispensable part of my life here. I hope that no matter the distance or the passage of time, our bond will always remain strong.

To my colleague and friend Alice, to whom this PhD journey brought into my life. I feel so fortunate to have had her support and kindness, always brightening my days with her warm smile and wonderful sense of humour.

I will always be grateful to Carezza and Rodrigo, my first supervisors, who guided me into the world of science. Thank you for your support and encouragement when I decided to do my PhD.

Finally, I would like to acknowledge ANID (Agencia Nacional de Investigación y Desarrollo Chile) - Scholarship ID 72200153 for supporting my PhD studies, and the University of East Anglia (UEA) for accepting my application and providing me with this incredible opportunity.

"Home is not where you are from, it's where you belong. And sometimes, you find that place in the most unexpected corners of the world" – B.T.

Chapter 1 Introduction

1.1 Background

Biodiversity, encompassing the variety of species, ecosystems, and genetic diversity, is vital for ecosystem resilience and human well-being (Cardinale et al., 2012). Globally, biodiversity underpins critical services such as water purification, climate regulation, and food security, making its conservation essential for sustainable development (Millennium Ecosystem Assessment, 2005). Despite its importance, biodiversity is in rapid decline (Díaz et al., 2019). Anthropogenic threats are mostly acting as drivers of biodiversity change in many environments across the Earth (Bowler et al., 2020). The rapid growth and expansion of the human populations (McKee et al., 2004) and increase in extraction of natural resources and primary productivity (Wackernagel et al., 2021) has become one of the greatest threats to biodiversity and ecosystem function. Human-induced habitat loss is one of the main drivers of biodiversity loss (Balmford & Bond, 2005; Cardinale et al., 2012; Duffy, 2003). A diverse range of conservation instruments has been applied to protect biodiversity (Tilman et al., 2017) and reduce pressure from infrastructure development (Laurance et al., 2015). Despite these efforts, the Intergovernmental Panel on Climate Change (IPCC) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) reports indicate that the unsustainable use of natural resources derived from anthropogenic activities continues (IPBES, 2019; IPCC, 2023). In this regard, international frameworks, such as the Convention on Biological Diversity (CBD), adopted in 1992, aim to address biodiversity loss through global commitments like the Aichi Biodiversity Targets and, more recently, the Kunming-Montreal Global Biodiversity Framework (KMGBF), which sets ambitious goals for 2030 and beyond (CBD, 2022). Recently in 2024, the Conference of Parties 16 (COP 16) highlighted the need for harmonising biodiversity and climate strategies, with resolutions to integrate the KMGBF and the Paris Agreement. Given the critical role that biodiversity plays in sustaining ecosystems and human well-being, its protection has become a priority in global conservation efforts. Among the various approaches to mitigate biodiversity loss, biodiversity offsetting has gained prominence as a tool for compensating for unavoidable environmental impacts, aiming to achieve ‘no net loss’ or even a ‘net gain’ of biodiversity (Moilanen & Kotiaho, 2021).

Biodiversity offsetting has emerged as a tool to mitigate the environmental impacts of development by ensuring that unavoidable biodiversity losses are compensated for through equivalent biodiversity gains (Bull et al., 2013). Biodiversity offsetting involves compensating

for ecological losses by creating ecological gains through measures such as ecological restoration, the creation of new protected areas, or various forms of habitat management (zu Ermgassen et al., 2019). The overall concept is that development projects should lead to 'no net loss' and even achieve a 'net gain' or 'net positive impact' on biodiversity (Moilanen & Kotiaho, 2021). Biodiversity offsetting has been a common practice since at least the 1970s in Europe (Damiens et al., 2021b), with the practice spreading globally through the adoption of a diverse range of governance approaches to biodiversity offsetting (GIBOP, 2019). The development of these approaches has been driven by the collaborative efforts of various stakeholders, including governments, Non-Governmental Organizations (NGOs), businesses, and academia (Souza et al., 2023). Policy advocates such as the Business and Biodiversity Offsets Programme (BBOP) have established standards and biodiversity offset mechanisms that draw on the terminology and experiences of members (Damiens et al., 2021b). This practice is aligned with the mitigation hierarchy, a framework that prioritises actions to avoid, minimise and restore negative impacts on biodiversity before considering compensatory measures (BBOP, 2012b). It emerged in the United States in 1970 and it was being used in around 40 countries by 2023 (Pelta et al., 2023). The hierarchy can vary in detail in different contexts, but typically consists of the following steps: (1) avoidance, where measures are taken to prevent biodiversity loss, (2) minimisation, which involves reducing the duration, intensity, or extent of impacts, (3) restoration, aiming to rehabilitate degraded ecosystems, (4) offsetting, which compensates for any remaining residual impacts by protecting or enhancing biodiversity elsewhere (Glasson & Therivel, 2019). As biodiversity offsetting has evolved, it has increasingly been incorporated into regulatory frameworks to ensure that development projects account for their environmental impacts (TBC, 2013). A key mechanism for this integration is the Environmental Impact Assessment (EIA) System, which plays a critical role in identifying, assessing, and mitigating the potential environmental consequences of proposed projects.

Environmental Impact Assessments (EIA) are widely recognised as critical tools for integrating environmental considerations into decision-making processes (Morgan, 2012). By assessing potential environmental impacts before development projects proceed, EIA helps to plan the mitigation of adverse effects and promotes more sustainable outcomes (Glasson & Therivel, 2019). EIA aims to anticipate the environmental consequences of proposed development projects, allowing stakeholders to identify, assess, and mitigate potential negative impacts before they occur (Glasson & Therivel, 2019; Noble, 2010). By systematically evaluating the effects of projects on the environment—such as land use changes, pollution, habitat

destruction, and resource depletion—EIAs provide valuable insights to decision-makers, enabling them to make informed choices that balance development needs with environmental protection (Jay et al., 2007). In recent years, there has been growing attention on the role of EIA in protecting biodiversity, with countries increasingly incorporating biodiversity offset requirements into EIA processes (Villarroya et al., 2014). While EIA systems have proven essential for integrating environmental considerations into development planning, their effectiveness in addressing biodiversity loss varies across countries (Bataineh, 2007; de Witt et al., 2019; Wale & Yalew, 2010). In Chile, a country renowned for its rich and unique biodiversity, the integration of biodiversity considerations into the EIA process has been under development over the last decade and presents both challenges and opportunities.

Chile is a biodiversity hotspot, with unique ecosystems ranging from the Atacama Desert in the north to the temperate rainforests of the south (Myers et al., 2000). These ecosystems face significant threats from activities such as mining, agriculture, and urban expansion (Pauchard et al., 2006). In Chile, the regulatory framework for biodiversity offsets (known as 'appropriate compensation of biodiversity') (Cares et al., 2023) is embedded within the *Sistema de Evaluación de Impacto Ambiental* [Environmental Impact Assessment System (EIAS)], which requires that development projects assess and mitigate, repair or compensate environmental impacts (Rodríguez-Luna et al., 2021). In 2014 the first *Guía para la compensación de biodiversidad en el SEIA* [Guide for Biodiversity Compensation in the EIAS] was published by the *Servicio de Evaluación Ambiental* [Environmental Assessment Service] (SEA, 2014), which was a guide that detailed the minimum essential elements required for appropriate compensation for biodiversity loss. This 2014 guide, which standardises criteria, requirements, conditions, and technical specifications for implementing appropriate biodiversity compensation, as well as ensuring adherence to the regulatory framework in Chile, was updated in 2022 to reduce the scope for discretionary decision-making (SEA, 2022). Additionally, a methodology guide for the design and implementation of biodiversity compensation measures was published (SEA, 2023a), alongside a guide for citizen participation in the EIA System (SEA, 2023b).

Given Chile's international commitments to biodiversity conservation, particularly through its obligations under the CBD, there is a need for effective tools to combat biodiversity loss (Carranza et al., 2020). Whilst Chile's existing EIA System provides a foundational framework for environmental protection, it has been found to fall short in terms of integrating biodiversity

offsets into national practice (Gamberini et al., 2019). This gap presents an opportunity for policy innovation and improvement, especially as Chile seeks to align its national biodiversity goals with international best practices, such as the 'no net loss' approach (SEA, 2014; SEA, 2022). By evaluating the effectiveness of the current system and identifying areas for enhancement, this research aims to contribute to improved biodiversity outcomes.

1.2 Purpose of the study

The purpose of this research is to evaluate how the Environmental Impact Assessment System in Chile, along with other environmental decision-support tools, can effectively contribute to the reduction of biodiversity loss in accordance with current national environmental legislation. This study aims to identify the strengths and weaknesses of the existing EIA framework in integrating biodiversity considerations and to explore opportunities for enhancing its effectiveness. By analysing the interplay between policy and practice, this research seeks to provide actionable insights that can inform policymakers and stakeholders, ultimately promoting better biodiversity outcomes in Chile.

This research addresses a relatively underexplored area, in the context of Chile, by examining the integration of biodiversity offset (compensation of biodiversity) requirements into the EIA framework. While biodiversity conservation is often discussed in environmental policy (Bhola et al., 2021; Brockett et al., 2023; Rands et al., 2010), this study specifically focuses on how EIA can operationalise these concepts in practice. By focusing on the Chilean EIA System, this research contributes to the understanding of biodiversity governance within a Latin American context, which has unique ecological and socio-economic challenges (Brassiolo et al., 2023). This localised approach offers insights that may be applicable to other regions, filling a gap in the existing literature on the role of environmental assessments in protecting biodiversity in developing countries.

This research uses a combination of quantitative and qualitative methods, including interviews and focus groups, allowing for a comprehensive understanding of stakeholder perspectives and practice related to compensation of biodiversity in the EIA System in Chile. This methodological diversity enhances the depth and richness of the findings. Moreover, the research not only evaluates Chilean practice but also compares the national policies with international benchmarks, identifying gaps and opportunities for improvement. This comparative analysis can provide valuable lessons both for Chile and other countries facing

similar biodiversity challenges. Ultimately, by translating findings into practical strategies for policymakers and practitioners, the study aims to influence real-world practices and contribute to enhanced biodiversity outcomes in Chile.

1.3 Research question and objectives

The concept of no net loss (NNL) of biodiversity is seen as essential for conservation efforts globally to achieve their goals, particularly in the context of development projects that may negatively impact natural ecosystems (Damiens et al., 2021a). EIA is a critical tool designed to evaluate and mitigate the environmental impacts of proposed developments, making it a suitable host process for efforts to achieve NNL (Glasson & Therivel, 2019). In Chile, where biodiversity is both rich and threatened, understanding how the EIA System can effectively contribute to this goal is particularly important. Therefore, the research question for this study is 'How can the EIA System in Chile help to achieve no net loss of biodiversity?'. This research question is significant for three reasons as set out below.

Firstly, with increasing pressures from development, the need to safeguard biodiversity is more urgent than ever. Chile's rich biodiversity, particularly its unique and endemic species, faces significant threats from land-use changes, resource extraction, and infrastructure development (Pauchard et al., 2006). Evaluating the EIA System's role in achieving NNL can provide insights into how to balance economic development with biodiversity protection, an important aspect in a developing country like Chile.

Secondly, the research question is critical because it addresses the effectiveness of Chile's current legal and regulatory framework in achieving NNL goals. While biodiversity offsetting and environmental safeguards have become common components of EIA globally (Middle & Middle, 2010; Villarroya et al., 2014), the effectiveness of these measures in Chile has not been thoroughly analysed, considering that biodiversity offsets were including in the EIA System one decade ago. By focusing on how the EIA System in Chile integrates biodiversity compensation requirements, this study aims to assess whether the System is fulfilling its intended role in protecting biodiversity.

Finally, this research question highlights the opportunity to propose improvements to the EIA System in terms of compensation of biodiversity. Identifying gaps in the current approach and offering practical recommendations can directly influence policy and practice. By addressing

these gaps, Chile could enhance the protection of biodiversity while still supporting economic development.

To answer this research question, three objectives were developed:

Objective 1: To evaluate Chilean policy in relation to international benchmarks

This objective focuses on assessing how environmental guidelines and regulations in Chile (together comprising the policy) align with international best practices for biodiversity offsetting. By comparing Chile's policies to established international benchmarks, this evaluation can identify gaps in legislative frameworks and guidelines and highlight areas where Chile could enhance its approach to biodiversity offsetting. The evaluation will involve a comprehensive literature review of existing policies, regulations, and international agreements, such as the Business and Biodiversity Offsets Programme (BBOP), to determine how effectively Chilean policies support the objectives of biodiversity compensation.

Objective 2: To evaluate Chilean practice in relation to national obligations

This objective aims to analyse the practical implementation of compensation of biodiversity through the EIA System in Chile, specifically how it adheres to national environmental obligations concerning biodiversity. Understanding the gap between policy and practice is critical for effective biodiversity compensation. This objective will help identify challenges and barriers that EIA practitioners face in fulfilling national obligations within the EIA framework. This evaluation will include quantitative data used for sample selection, and qualitative data collected through interviews with EIA stakeholders. The analysis will focus on illustrating how the EIA process incorporates biodiversity considerations and the effectiveness of these practices in achieving desired biodiversity outcomes.

Objective 3: To identify the opportunities for improving biodiversity outcomes in Chile

This objective seeks to explore and identify specific opportunities for enhancing biodiversity outcomes through the EIA System in Chile and related environmental policy. By focusing on potential improvements, this research can contribute to the development of more effective strategies for biodiversity offsetting and conservation, directly influencing policy and practice in Chile. This analysis will involve synthesising findings from the previous objectives and

engaging stakeholders through a focus group session, to debate innovative solutions and best practices.

1.4 Organisation of the study

This thesis consists of eight chapters. Chapter One presents the background to the research and highlights its significance. It situates the study within both the international and national contexts, outlining the purpose of the research, the research question, and its objectives.

Chapter Two presents the literature review, providing a comprehensive overview of the existing research and knowledge related to EIA, biodiversity offsetting, and the concept of no net loss of biodiversity. It examines international best practices, as well as the specific application of these concepts in the Chilean context. The chapter also identifies gaps in the current literature that this research aims to address.

Chapter Three describes the methodological approach used in this study. It outlines the research design, which employs a pragmatist approach combining both qualitative and quantitative methods. The chapter explains the use of grounded theory for qualitative data collection through interviews and focus groups, as well as the use of secondary data for quantitative analysis. It also details the sampling strategy, data collection procedures, and the analytical methods employed to address the research question and objectives.

Chapter Four reports the results from the comparative analysis. This chapter evaluates Chilean policies related to compensation of biodiversity in EIA against international benchmarks, corresponding to the first objective of the thesis. It analyses how well Chile's EIA System aligns with global standards for achieving no net loss of biodiversity and identifies key differences, strengths, and weaknesses.

Chapter Five examines the results of the case study selection and focuses on a quantitative analysis to investigate the implementation of the mitigation hierarchy in Chile, as part one of the second objective of the thesis. The aim is to evaluate the extent to which biodiversity is being protected by the Chilean environmental legislation in practice, specifically through the application of the mitigation hierarchy.

Chapter Six explores the qualitative analysis based on interviews conducted with key stakeholders, as part two of the second objective of the thesis. This chapter delves into the

insights gathered from these interviews, which include perspectives from government officials, environmental consultants, and developer representatives. The analysis highlights key themes related to the effectiveness of the EIA System in achieving no net loss of biodiversity in Chile.

Chapter Seven examines the qualitative findings from the focus group (and supplementary interviews), for the third objective of the thesis. This chapter provides an in-depth analysis of the insights and opinions expressed by participants, focusing on their views regarding the role of biodiversity compensation in the EIA System. The conversations explore challenges, opportunities, and practical recommendations for enhancing the EIA process to achieve no net loss of biodiversity in Chile.

Chapter Eight provides the conclusions of the study, summarising the key findings and their implications for biodiversity protection within Chile's EIA System, reflecting on practical recommendations for EIA stakeholders on improving the integration of biodiversity compensation into the EIA process. The chapter also identifies both the strengths and weaknesses of this study. Finally, the contributions of the study are discussed, highlighting its relevance to the broader field of environmental assessment and biodiversity compensation (outside Chile), and its potential to inform future policy developments and research.

This thesis includes one published paper in the academic journal Environmental Impact Assessment Review. The chapters of the thesis that have been based on this work correspond to section 2.6 Chapter 2, section 3.5 and 3.6 Chapter 3, and Chapter 5. Dr. Alan Bond and Dr. Aldina Franco appear as co-authors, with the authorship contribution is as follows:

Rocío A. Cares: Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing – original draft, Writing – review & editing, Visualization, Supervision, Funding acquisition.

Aldina M.A. Franco: Conceptualization, Validation, Formal analysis, Writing – review & editing, Visualization, Supervision, Project administration.

Alan Bond: Conceptualization, Methodology, Validation, Formal analysis, Writing – review & editing, Visualization, Supervision, Project administration.

Citations for this publications is:

Cares, R. A., Franco, A. M. A., & Bond, A. (2023). Investigating the implementation of the mitigation hierarchy approach in environmental impact assessment in relation to biodiversity impacts. *Environmental Impact Assessment Review*, *102*. https://doi.org/https://doi.org/10.1016/j.eiar.2023.107214

Chapter 2 Literature review

2.1 Introduction

The purpose of this literature review is to provide a comprehensive overview of the existing research on Environmental Impact Assessment (EIA) and biodiversity offsetting, focusing on their role in achieving no net loss (NNL) of biodiversity. This review establishes a foundational understanding of how EIA is used globally to assess, mitigate, and offset the impacts of development projects on biodiversity and evaluates how these processes have been implemented and adapted in various national contexts, particularly in Chile. Additionally, it seeks to identify key challenges, best practices, and gaps in the current literature that may inform improvements to the Chilean EIA framework.

This review is structured to achieve several objectives. First, it explores the concept of biodiversity and the importance of NNL in conservation efforts, highlighting the urgency of addressing biodiversity loss through structured environmental policies. Second, it examines the evolution of EIA as a tool for integrating environmental concerns into development decisions, with an emphasis on how EIA incorporates biodiversity considerations and offsetting measures. Third, it reviews the theory and practice of biodiversity offsetting within EIA frameworks, giving examples from countries that have integrated these practices into their environmental policies. Finally, the review focuses on the specific EIA System in Chile, evaluating its approach to biodiversity compensation and the degree to which it aligns with international standards.

By critically analysing the strengths and limitations of EIA approaches to NNL within the current literature, this review not only contextualises the research question but also identifies gaps that justify the need for this study. The findings from this review will guide the research by informing recommendations aimed at enhancing Chile's EIA System to achieve NNL of biodiversity more effectively.

2.2 Conceptualising biodiversity and no net loss of biodiversity

Biodiversity, or biological diversity, encompasses the variety of life on Earth at multiple levels, including genetic, species, and ecosystem diversity (CBD, 1992). It refers not only to the different species within a particular region but also to the variation within individual species—known as genetic diversity—which allows populations to adapt to changing

environments and resist diseases (Frankham et al., 2002). This diversity of life includes intricate ecosystems such as forests, wetlands, and coral reefs, where species interactions contribute to the functionality and resilience of ecological processes (Naeem et al., 2012). Genetic diversity within species plays a critical role in maintaining population health, as it enhances adaptability and survival under environmental pressures (Frankham et al., 2002). Similarly, ecosystem diversity—the range of different habitats, communities, and ecological processes—supports ecosystem services that are essential for human survival, such as air and water purification, nutrient cycling, and climate regulation (Cardinale et al., 2012; Chivian, 2002). The protection of biodiversity at all these levels is fundamental to sustaining both environmental and human health, as well as supporting cultural and economic values across societies (Millennium Ecosystem Assessment, 2005).

2.2.1 Biodiversity and global threats

Anthropogenic, or human-induced, threats have become the primary drivers of biodiversity change across diverse ecosystems worldwide (Bowler et al., 2020). Human activities—such as deforestation, pollution, habitat fragmentation, overexploitation of natural resources, and climate change—exert unprecedented pressures on natural environments, leading to significant biodiversity loss (Balmford & Bond, 2005; Díaz et al., 2019). These activities alter habitats, reduce species populations, and disturb ecological processes, making ecosystems more vulnerable to additional stressors and reducing their resilience to change (Sala et al., 2000). Land-use changes for agriculture, urban development, and infrastructure are among the most significant threats to biodiversity, as they cause habitat destruction and fragmentation (Bowler et al., 2020; McKinney, 2006). This process isolates populations, limits gene flow, and increases species' susceptibility to extinction (Newbold et al., 2015). Additionally, pollution, including plastic waste, chemical runoff, and air pollution, degrades ecosystems and poses direct threats to species, particularly in freshwater and marine environments (Halpern et al., 2008).

Biodiversity loss is driven by population growth and the expansion of human activities, becoming one of the greatest threats to species biodiversity and ecosystem function (McKee et al., 2004), and deteriorating the ecosystem services on which humanity depends (Brooks et al., 2006). If human impacts on biodiversity continue unchanged, the planet's most biologically diverse regions—often referred to as biodiversity hotspots—will face significantly elevated extinction risks in the near future (Tilman et al., 2017). These regions, which host the greatest

concentrations of endemic species, are particularly vulnerable to human-driven threats such as habitat destruction, climate change, pollution, and overexploitation (Myers et al., 2000). Without substantial mitigation efforts, continued pressure from these drivers is likely to result in the loss of unique species and ecosystems, many of which provide critical ecosystem services and play key roles in global ecological stability (Newbold et al., 2015). Preventing this outcome will require urgent, coordinated efforts to reduce human impacts, protect critical habitats, and restore degraded ecosystems. Focusing conservation and policy efforts on these biologically rich but threatened regions could help mitigate the extinction risks associated with continued human expansion and resource use (IPBES, 2019).

2.2.2 No net loss of biodiversity

The concept of No Net Loss (NNL) of biodiversity is a conservation goal aimed at ensuring that development projects or human activities do not result in an overall decline in biodiversity. NNL policies require that any unavoidable losses of biodiversity from a development must be offset through measures that ensure an equivalent or greater gain in biodiversity elsewhere, ideally leading to an overall neutral or positive impact on the natural environment (BBOP, 2012c). Implementing NNL therefore requires rigorous planning, monitoring, and long-term commitment to ensure that biodiversity impacts are fully counterbalanced (Bull et al., 2013; Maron et al., 2012). NNL has been integrated into various national policies and international standards aiming to balance development and conservation (Kiesecker et al., 2010; McKenney & Kiesecker, 2010; ten Kate et al., 2004; TBC, 2013). Organisations such as the Business and Biodiversity Offsets Programme (BBOP) have developed frameworks and guidelines for implementing NNL, and it has been adopted in sectors including mining, energy, and infrastructure (BBOP, 2012c).

Despite the growing emphasis, achieving NNL remains complex and challenging. Implementation issues include defining equivalency in biodiversity values, ensuring long-term monitoring, and securing financial and regulatory commitments (Dias et al., 2017; Gardner et al., 2013; Lindenmayer et al., 2017; Moilanen et al., 2024). Additionally, the risk of NNL policies being used to legitimise, rather than prevent, ongoing habitat destruction by development projects is a key concern (Spash, 2015). Moving forward, the effective implementation of NNL requires rigorous monitoring, transparent reporting, and strengthened policy frameworks to genuinely offset biodiversity impacts (Bull et al., 2017b; Quétier et al.,

2014), as NNL remains a vital approach for harmonising development with biodiversity conservation, reinforcing the global commitment to sustainable development goals.

2.3 EIA and its role in biodiversity conservation

EIA as a generic process (specific requirements in individual jurisdictions may differ) involves an assessment of the impacts of a proposed development, including the identification of mitigation measures to address potentially significant impacts, and subsequent monitoring to determine the environmental outcomes (Glasson & Therivel, 2019). Introduced in the United States with the National Environmental Policy Act (NEPA) of 1969 (O'Riordan & Sewell, 1981), EIA was initially established to ensure that environmental considerations were integrated into federal decision-making processes, and then it was implemented by many countries as a means of balancing economic development with environmental protection (Morgan, 2012). The primary objective of EIA systems is to provide a systematic and transparent approach to assessing the environmental implications of proposed projects before they begin (Glasson & Therivel, 2019). The EIA process typically involves several stages, including scoping (deciding the focus of the EIA), impact assessment (predicting and assessing the impacts on different environmental components), public participation, and the development of mitigation strategies to avoid or reduce the predicted impacts (Morgan, 2012). Monitoring programs are also integral, ensuring that project impacts remain within acceptable limits throughout their lifecycle (Dipper, 1998).

In recent decades, biodiversity considerations have become integral to EIA processes worldwide. Recognising the critical importance of ecosystems and biodiversity for sustaining life and mitigating climate change, many countries have adapted their EIA frameworks to explicitly include biodiversity impact assessments, as well as mechanisms for biodiversity offsetting and NNL goals (de Witt et al., 2019; Kiesecker et al., 2010; McKenney & Kiesecker, 2010). Implementing NNL in EIA has gained traction, especially in biodiversity-rich regions where development projects may pose significant environmental risks (GIBOP, 2019). The growing emphasis on NNL reflects a collective response to unprecedented rates of biodiversity loss due to human activities, as highlighted by various international frameworks and standards, including the Convention on Biological Diversity (CBD, 1992), the International Finance Corporation Performance Standard 6 (IFC, 2019), and other key guidelines. These policies reflect an increasing trend to incorporate biodiversity offsets into regulatory frameworks, particularly for projects located in ecologically sensitive areas.

While EIA systems are valuable for integrating biodiversity considerations into development planning, they face numerous challenges in fully addressing biodiversity loss. The technical limitations of biodiversity assessment, along with enforcement gaps and inconsistent offset policies, hinder the effectiveness of EIA systems in achieving NNL objectives (Bataineh, 2007; Bigard et al., 2017; Brownlie et al., 2013; Bull et al., 2017b; Dias et al., 2017). Addressing these challenges will require enhanced technical capacities for biodiversity assessment, stronger regulatory frameworks for compliance and enforcement, and more rigorous and inclusive stakeholder engagement processes. Future EIA reforms might also focus on establishing more stringent biodiversity offset criteria and developing reliable long-term monitoring systems. These improvements could increase the capacity of EIA systems to contribute to biodiversity conservation goals and support a more sustainable balance between development and environmental protection.

2.4 Biodiversity Offsetting and International Best Practices for EIA

Biodiversity offsetting is a conservation strategy aimed at compensating for unavoidable biodiversity losses resulting from development projects by creating equivalent biodiversity gains elsewhere (Bull et al., 2013; BBOP, 2012c). Typically integrated into EIA processes, biodiversity offsets seek to achieve ‘no net loss’ or, ideally, a ‘net gain’ on biodiversity (BBOP, 2018a; Moilanen & Kotiaho, 2021). This approach follows the mitigation hierarchy to address the environmental impacts of a development project (Glasson & Therivel, 2019). This process begins with avoidance and minimisation, where planners prioritise avoiding harm to sensitive ecosystems and species in the initial stages of a project. By prioritising avoidance, the mitigation hierarchy seeks to reduce harm to biodiversity before resorting to offsets (Phalan et al., 2018). For impacts that cannot be avoided or minimised, projects may incorporate efforts to restore or rehabilitate ecosystems (restoration) directly affected by the development to reduce net loss (Kiesecker et al., 2010). However, if residual impacts remain, biodiversity offsets are implemented as a last resort (BBOP, 2012c; Ekstrom et al., 2015; Tucker et al., 2020), often through creating or conserving similar habitats in other locations to counterbalance the loss (Bull & Strange, 2018; Gardner et al., 2013) (Figure 2.1). Glasson and Therivel (2019) also refer to the inclusion of measures in EIA to create environmental benefits beyond pure mitigation of impacts (enhancement), which can help to highlight the opportunities for the EIA process to deliver benefits as well as controlling negative impacts only. The correct implementation of the mitigation hierarchy is argued to be better (than incorrect

implementation) for biodiversity, reducing the need for short-term restoration and offsetting, and preventing the need to deal with subsequent problems such as long-term restoration, uncertainty over the effectiveness of any offsets, the cost of the monitoring for the duration of the offsets, as well as negative social impacts (Lindenmayer et al., 2017; Maron et al., 2016; Phalan et al., 2018).

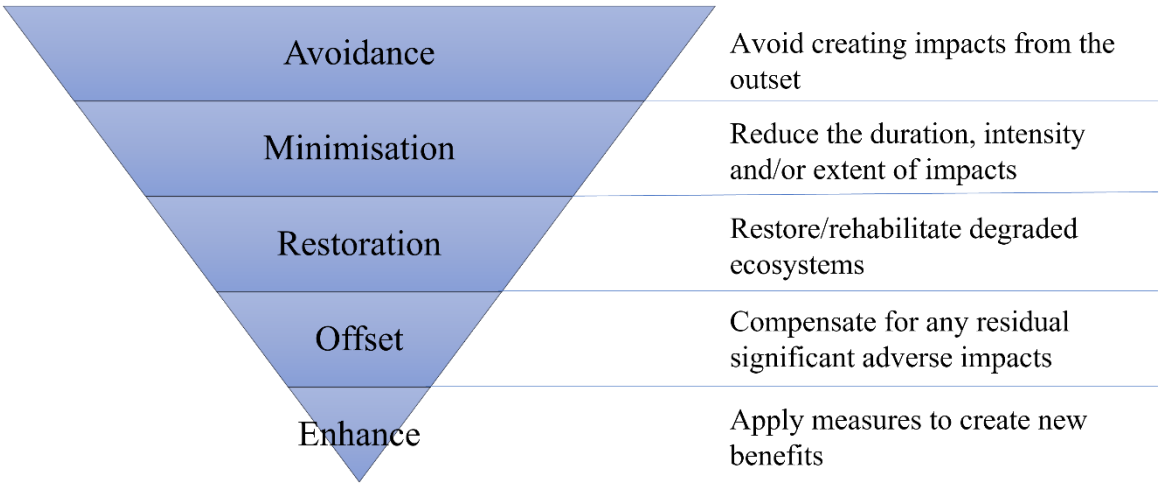

Figure 2.1 The mitigation hierarchy (adapted from Glasson and Therivel, 2019)

The success of the implementation of the mitigation hierarchy relies on the execution of post-decision monitoring to verify the effectiveness of the mitigation measures (Drayson & Thompson, 2013; Morrison-Saunders et al., 2021; Sánchez & Gallardo, 2005). Monitoring in the environmental assessment context is defined as the collection of data after the implementation of the activity to evaluate the environmental performance of a project or plan (Morrison-Saunders et al., 2021). Monitoring involves the measuring of environmental variables and parameters of interest over a period of time, in order to obtain information on the general state of the environment (Arts et al., 2001). To be more effective, monitoring should evaluate those parameters more susceptible to, and expected to be affected by, changes in the environmental conditions, facilitating the reduction of uncertainty associated with the predictions (Glasson, 1994).

As the central objective of the mitigation hierarchy is to at least reach ecological equivalence between biodiversity losses caused by the impacts of a development project and the gains produced by offsetting (Boileau et al., 2022; Gelot & Bigard, 2021), EIA-related biodiversity monitoring is essential to determine the effectiveness of the measures implemented to minimise the impacts on biodiversity resulting from development activities (Bataineh, 2007; Pickett et

al., 2013). Once the measures have been appropriately implemented, monitoring the effectiveness of the measures verifies whether they have delivered the intended biodiversity outcome (Drayson & Thompson, 2013). In this regard, biodiversity monitoring programs should focus both on the process and the outcomes to establish whether the results of the process met the expected purposes (Chanchitpricha & Bond, 2013). Also, verifying biodiversity outcomes is needed to provide a feedback loop to increase the effectiveness of mitigation measures and effectively contribute to minimising development impacts on biodiversity (Gelot & Bigard, 2021; Quétier & Lavorel, 2011).

Organisations such as the BBOP and the International Finance Corporation (IFC) provide standards and guidelines to ensure effective and ethical implementation of offsets globally (BBOP, 2012c; IFC, 2019). These frameworks emphasise accountability, transparency, and adherence to the mitigation hierarchy, encouraging projects to minimise impacts before resorting to offsets. Additionally, several key principles underpin biodiversity offsetting, including equivalence, additionality, long-term outcomes, stakeholder engagement among others (Brownlie & Treweek, 2018; BBOP, 2012c; de Witt et al., 2019; Maron et al., 2021b; Souza et al., 2023). Chapter 4 provides an in-depth review of international best practices for biodiversity offsetting within the EIA framework. This chapter critically examines and compares these practices against Chile's biodiversity offset policies, highlighting areas for potential alignment and improvement, as part of the first objective of this thesis (see Section 1.3).

2.5 Biodiversity in Chile and the Chilean conservation framework

The biodiversity of Chile is known for its high degree of endemism and the exclusivity of some of its ecosystems, caused by the biogeographic conditions (MMA, 2019). Chile presents multiple types of ecosystems (terrestrial, marine, coastal and oceanic islands), which are critical to the economic development and social well-being of the population, and which fulfil crucial functions for maintaining key ecosystem services (Lara et al., 2009). Chile has one of the five Mediterranean-climate regions known in the world (McNally, 1990); is characterised by a high endemicity of plants and animals in the Juan Fernández Archipelago (Ormazabal, 1993); and hosts the Chilean Winter Rainfall-Valdivian Forest which is considered to be one of the 35 global biodiversity hotspots (Mittermeier et al., 2011). Also, it was recently found to possess 88 out of 110 global ecosystems existing on the planet (Keith et al., 2022). Currently, 37% of the national surface area of the country is under some form of natural heritage conservation

(official protected area), whether public or private, terrestrial, marine, lake or freshwater. It should be noted that in Chile, the development of investment projects within protected areas is not permitted. This policy aligns with the country's commitment to preserving biodiversity and maintaining the integrity of protected ecosystems.

The main pressures on terrestrial ecosystems in Chile are degradation and fragmentation due to human activities, such as changes in the use of land including forest reduction and conversion of shrubland to cultivated land, illegal logging of forests, and the creation of plantations with exotic species (Armesto & Arroyo, 1991; Lara et al., 2009; MMA, 2019). Negative impacts on biodiversity in Chile have been associated with agricultural and forestry industry, urbanisation, and mining, which produce the main pressures on fragile ecosystems through the clearing of native forests, the establishment of pastures and crops, the extraction of groundwater, and the contamination of aquifers (MMA, 2019).

Chile has adhered to numerous international treaties related to the conservation of its natural heritage, such as the Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere (1940), Ramsar Convention (1971), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, 1973), and CBD (1992) (UNDP, 2017). Additionally, in 2003, Chile implemented its National Biodiversity Strategy, which was updated in 2017 and currently runs from 2017-2030. The National Biodiversity Strategy is the instrument of public policy integrating the main strategic objectives, actions and goals of the country in terms of conservation and sustainable use of biodiversity (MMA, 2018). Furthermore, Chile agreed 20 targets (known as the 2010 Aichi biodiversity targets) aimed at reducing the loss of biological diversity at the global level, which are integrated in the National Biodiversity Strategy (MMA, 2018).

2.6 Chilean EIA System and its role in Biodiversity Conservation

Several national and international policy instruments (e.g., article 14 of the CBD) propose the application of EIA as a crucial instrument for minimising biodiversity loss (Slootweg & Kolhoff, 2003). All projects that are likely to have significant adverse effects on biological diversity should use these instruments to avoid or minimise negative biodiversity impacts (CBD, 1992). Chile as one of the signatories of the CBD implemented environmental legislation in 1994 through the Law Nº19,300 on *Bases Generales del Medio Ambiente* (General Environmental Bases) (MINSEGPRES, 1994) to meet its CBD obligations, including

a requirement for EIA. In 2010, Law Nº20,417 modified Law Nº19,300, creating the *Ministerio de Medio Ambiente* (Ministry of Environment), the *Servicio de Evaluación Ambiental* (Environmental Assessment Service), and the *Superintendencia de Medio Ambiente* (Superintendency of the Environment). Moreover, to administer the increasing number of biodiversity protection commitments, Chile has recently approved Law Nº 21,600 (MINSEGPRES, 2023) with the creation of the *Servicio de Biodiversidad y Áreas Protegidas* (Biodiversity and Protected Areas Service) (Figure 2.2).

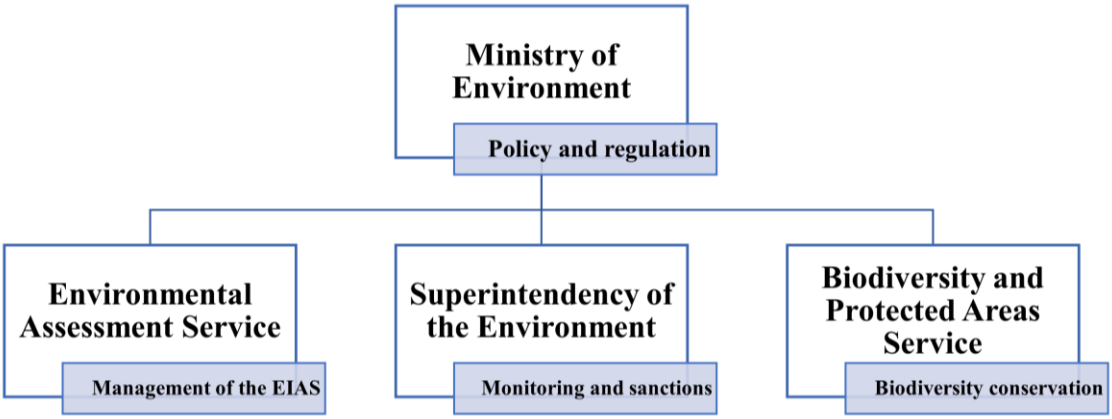

Figure 2.2 Environmental institutions in Chile

The Environmental Assessment Service (henceforth referred to as the Service) has implemented and managed the *Sistema de Evaluación de Impacto Ambiental* [Environmental Impact Assessment System, EIAS] in Chile since 2010 (MINSEGPRES, 2010). The process, showed in Figure 2.3, begins with the developer submitting the project to the EIAS. This is followed by a screening phase, where it is determined whether the project is likely to cause environmental impacts, based on the list of activities outlined in Article 3 of the *Reglamento del Sistema de Evaluación de Impacto Ambiental* [Environmental Impact Assessment System Regulation, EIASR] (MMA, 2012). Next, during the scoping phase, it is determined whether the project should be submitted as a *Declaración de Impacto Ambiental* [Environmental Impact Declaration, EID] or an *Estudio de Impacto Ambiental* [Environmental Impact Study, EIS]. The EID, submitted under oath, describes the project and rules out impacts specified in Articles 5 to 10 of the EIASR, whilst the EIS provides detailed, evidence-based information for predicting and identifying the environmental impacts described in the same articles (MMA, 2012; Rodríguez-Luna et al., 2021). Once the EID or EIS is reviewed by the Service, the documentation may be forwarded to government agencies with environmental expertise for

technical feedback. Based on their input, the Service can request modifications or additional information to complement or amend the documentation. Finally, the Service prepares a recommendation to approve or reject the project, which is submitted to the evaluation commission responsible for making the final decision. The evaluation commission is composed of the Representative of the President in the region, and the Regional Secretaries of the Ministries of the Environment, Health, Economy, Development and Reconstruction, Energy, Public Works, Agriculture, Housing and Urban Development, Transport and Telecommunications, Mining, and Planning, and the Regional Director of the Service, who will act as secretary. If the project is granted planning approval, a Resolution of Environmental Qualification (*Resolución de Calificación Ambiental*, RCA) is granted. This document sets out the conditions and requirements that the developer's project must comply with during its implementation, including the measures and monitoring obligations, indicating the form and location of implementation, details of the measure that will be monitored, the component of biodiversity affected, timing, and the indicator that will be monitored, corresponding to the target to be measured to verify the success of the measures (MINSEGPRES, 1994).

Post-approval of the project, the Superintendency of the Environment is responsible for executing, organising, and coordinating the monitoring and ensuring compliance with the terms of the planning permission. In this regard, the Superintendency of the Environment oversees receiving the monitoring reports prepared by the developers, following the guidelines established in the RCA, auditing the projects, and acting as a compliance and enforcement agency (MINSEGPRES, 2010). Monitoring in Chile is mandatory for all the projects which have declared significant impacts, and the duration of the monitoring is stated to be for the lifetime of the project or an equivalent time, which is decided by the relevant authority before the permission is granted. The monitoring reports in Chile are required for all the stages of the project (construction, operation, and decommissioning). The proponents should periodically submit monitoring reports to the Superintendency of the Environment, which can perform audits to verify the accuracy of the monitoring programs, imposing sanctions or fines if the conditions according to what was established in the RCA are not being fulfilled (MMA, 2012).

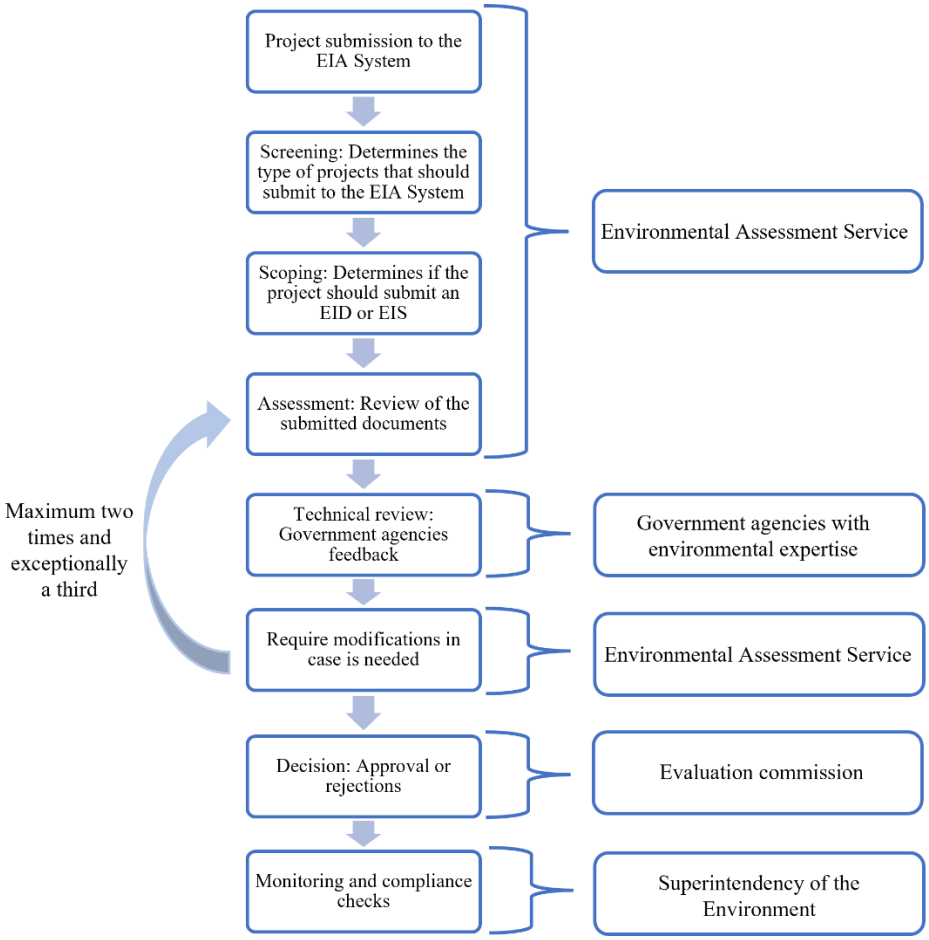

Figure 2.3 Environmental Assessment process in Chile

Since the commencement of the Service's operation in 2010, a total of 12,912 projects have been submitted to the EIAS. As of 2024, 6,610 projects have received approval, 326 have been rejected, and the remainder were either withdrawn, expired, not admitted, abandoned, or revoked. Those projects not covered by Article 3 of the EIASR are considered for approval by the Works Department of the corresponding municipality, although they may voluntarily opt-in to the EIA System to obtain environmental certification (MINSEGPRES, 1994). Table 2.1 presents the number of approved projects per productive sector by year in Chile. This information is publicly available and can be accessed through the official records of the Environmental Assessment Service (https://www.sea.gob.cl/documentacion/reportes/informacion-de-proyectos-ingresados-al-seia).

Table 2.1 Number of approved projects/productive sector/year

Productive sector	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total
Energy	90	105	134	74	90	106	70	101	136	240	227	99	98	7	**1577**
Sanitation	342	147	170	32	51	36	44	45	28	36	31	22	23	0	**1007**
Mining	159	126	151	95	59	49	59	63	55	52	51	28	20	1	**968**
Housing	68	76	70	31	53	78	84	93	118	78	68	54	46	7	**924**
Fisheries	203	211	172	68	66	24	13	17	15	24	22	4	10	0	**849**
Others	87	88	77	39	58	43	46	32	25	29	24	26	21	2	**597**
Manufacture	34	35	43	9	9	6	9	14	7	14	4	6	7	1	**198**
Hydraulic	17	15	28	9	5	7	10	19	8	7	7	6	2	1	**141**
Agricultural	14	6	13	10	7	15	6	10	6	15	12	7	6	0	**127**
Transport	12	7	8	2	7	4	8	4	4	4	3	6	2	0	**71**
Port	17	10	9	3	3	3	3	5	2	1	3	2	0	1	**62**
Equipment	24	15	14	0	1	0	1	2	0	1	0	1	0	0	**59**
Forestry	3	4	2	3	1	1	1	5	4	0	4	1	1	0	**30**
Total	**1070**	**845**	**891**	**375**	**410**	**372**	**354**	**410**	**408**	**501**	**456**	**262**	**236**	**20**	**6610**

From 2014, the EIAS in Chile has included a requirement for biodiversity compensation for all the significant impacts that cannot be mitigated or repaired, known as 'appropriate compensation of biodiversity' in Chile, but better known globally as 'Biodiversity Offsets' (BBOP, 2012c). These requirements appeared in the first *Guía para la compensación de biodiversidad en el SEIA* [Guide for Biodiversity Compensation in the EIAS] published in 2014 by the Environmental Assessment Service (SEA, 2014), which was updated in 2022 to reduce the scope for discretionary decision-making (SEA, 2022) (henceforth referred to as the National Guides). This update is consistent with the guidelines set out in the National Biodiversity Strategy 2017-2030, which is the public policy instrument that establishes the main strategic guidelines and national targets for the conservation and sustainable use of biodiversity to 2030 (MMA, 2018). Additionally, responding to the need to establish a single methodology for the design and implementation of biodiversity offsetting measures, the first edition of the *Guía metodológica para la compensación de la biodiversidad en ecosistemas terrestres y acuáticos continentales* [Methodological Guide for the compensation of biodiversity in terrestrial and inland aquatic ecosystems] was published in 2022, establishing a specific and comprehensive methodology for the design and implementation of biodiversity compensation measures in terrestrial and inland aquatic ecosystems. This Guide was updated to a second edition in 2023, providing the developers with new technical specifications that

facilitate the practical application of the methodology (SEA, 2023a). These National Guides are binding to the EIAS, and demand that the design and methodology of compensation measures should be in line with the requirements set out in these National Guides.

The National Guides detail the minimum essential elements required for appropriate compensation for biodiversity loss, which requires the significant adverse effects identified in the EIS to be balanced by the positive effect, promoting a zero net loss of biodiversity as a result of the implementation of projects or activities, or even a net gain (SEA, 2022). All the EISs that identify significant impacts as a result of the impact assessment, have the obligation to present a plan with measures to mitigate, repair, or compensate the impacts, and also a monitoring plan. The National Guides highlight the principle of the hierarchy of measures (mitigation hierarchy) as the mainstay in the appropriate compensation of biodiversity (Mac Auliffe & Scagliotti, 2019). The mitigation hierarchy is defined in the National Guides as the sequential application of measures to reduce the potential negative impacts of development projects on biodiversity: (i) mitigation (which includes avoidance and minimisation, equivalent to the first two steps of the mitigation hierarchy typically set out in Figure 2.1); (ii) repair (corresponding to rehabilitation/restoration); and (iii) compensation (referred to as offsets). Mitigation and repair should be prioritised over compensation, in order to prevent biodiversity loss (SEA, 2022). It should be noted that the term compensation is usually associated with economic compensation and the term offset is used for biodiversity compensation (Alonso et al., 2020). However, in Spanish, the term compensation is used for both situations, which can cause confusion and, in some cases, can lead to compensation being associated with aspects not necessarily related to biodiversity, therefore failing to meet the aim of offsetting biodiversity loss (Alonso et al., 2020). In Chile, the term biodiversity compensation is used to refer to biodiversity offsetting (Bull et al., 2016), therefore it will be the term used in this research. Also in Chile, the mitigation hierarchy is called the 'hierarchy of measures', and the terms used differ somewhat from the terms outlined in Figure 2.1 as set out in Table 2.2.

Table 2.2 The mitigation hierarchy and the equivalent terms used in Chile

Mitigation hierarchy (after Glasson & Therivel, 2019)	Equivalent terms in Chile (SEA, 2014)
Avoid	Mitigation
Minimise	
Restore	Repair
Offset	Compensation
Enhance	[No equivalent]

2.7 Conclusions

The literature review highlights that while EIA has the potential to play a critical role in achieving NNL of biodiversity, practical and regulatory challenges limit its current effectiveness. Integrating international standards—like the IFC Performance Standards (IFC, 2019) and BBOP Guidelines (BBOP, 2018a)—can make a substantial difference in the development of practice. However, these examples also highlight significant obstacles in implementation, including inconsistencies in enforcement, technical difficulties in measuring biodiversity offsets, and the challenge of maintaining long-term monitoring (Bigard et al., 2017; Bull et al., 2017b; Souza et al., 2023; Weissgerber et al., 2019; zu Ermgassen et al., 2019).

In Chile, the potential to improve biodiversity outcomes through EIAs is promising yet requires dedicated improvements. This synthesis underscores the importance of advancing research on EIA and biodiversity offsetting in the Chilean context, which is directly related to the research question, "How can the EIA System in Chile help to achieve no net loss of biodiversity?" The concept of NNL has been incorporated into numerous national policies and international standards, aiming to balance development and conservation (Kiesecker et al., 2010; McKenney & Kiesecker, 2010; Salès et al., 2023a; ten Kate et al., 2004), and various frameworks and guidelines have been developed by global organizations to support this goal (BBOP, 2012c; IFC, 2019; IUCN, 2016). By examining these international best practices and standards, the literature review directly supports objective 1, providing a comparative framework to evaluate Chilean policy against international benchmarks. This comparative analysis is essential for understanding Chile's position in the global context and for identifying actionable pathways to strengthen its approach to biodiversity conservation. The literature also delves into national-level commitments and challenges, revealing how many countries have adapted their EIA frameworks to explicitly incorporate biodiversity impact assessments, mechanisms for biodiversity offsetting, and NNL goals (Bull et al., 2013; de Witt et al., 2019; Kiesecker et al., 2010; McKenney & Kiesecker, 2010; Salès et al., 2023b), supporting objective 2 by identifying how Chilean practices align with legal and institutional obligations. This analysis provides a critical lens through which to evaluate how effectively Chile's current EIA practices meet its national commitments to biodiversity conservation, leading the way for targeted improvements. Furthermore, the literature highlights key areas for reform and innovation (Bataineh, 2007; Bigard et al., 2017; Bull et al., 2017b; Lindenmayer et al., 2017), informing

objective 3 by identifying opportunities to enhance biodiversity outcomes. This study uses these insights to propose practical recommendations for strengthening Chile's EIA System, advancing biodiversity conservation while promoting sustainable development.

Chapter 3 Methodological Approach

The purpose of this research is to evaluate how the EIA system in Chile, along with other environmental decision-support tools, can best achieve a reduction in biodiversity loss, according to the current environmental national legislation. The research question is 'How can the EIA System in Chile help to achieve no net loss of biodiversity?'. To answer this research question, three objectives were developed: 1) to evaluate Chilean policy in relation to international benchmarks; 2) to evaluate Chilean practice in relation to national obligations, and 3) to identify the opportunities for improving biodiversity outcomes in Chile.

This research presents a pragmatist approach involving a combination of quantitative and qualitative methods (Bryman, 2016). The former is primarily used as the basis for sample selection, while the latter involves the collection and analysis of non-numerical data, to gather in-depth insights to answer the research questions. The qualitative research approach is based on grounded theory (Strauss & Corbin, 1990), utilising inductive reasoning (Glaser & Strauss, 1967) to derive hypotheses from the data collected. Data are gathered first, and concepts and patterns emerge inductively from the analysis. In addition, deductive reasoning is applied by testing the emerging concepts against pre-existing knowledge (Hyde, 2000). This combined use of inductive and deductive reasoning allows for a comprehensive analysis where theory is both generated from and applied to the data, aligning with the pragmatist approach of adapting methods based on the research questions (Mitchell, 2018). The qualitative data come from primary sources, including interviews and focus groups, which are suited to exploring participants' perceptions and opinions within the EIA process. The quantitative data are drawn from secondary sources, including relevant documents from the selected case studies, providing a broader contextual understanding.

3.1 Research paradigm

The appropriate compensation of biodiversity in the EIA process is based on evaluation methods and procedures existing in the national legislation seeking to manage biodiversity impacts associated with future developments projects. This could be associated with a positivist paradigm, which postulates that knowledge and human understanding is obtained through the observation, experimentation and reasoning based on experience (Comte, 1856). This paradigm depends on deductive logic, through which explanations can be obtained and used to make predictions based on measurable outcomes, to derive conclusions (Kivunja & Kuyini,

2017). However, the decision-making process also depends on the behaviour of the actors and stakeholders depending on value systems and viewpoints, not just the regulations and rules, which is framed within the constructivist paradigm, that seeks to understand the subjective world of human experience (Guba & Lincoln, 1989). In this paradigm, "*the emphasis is placed on understanding the individual and their interpretation of the world around them*" (Kivunja & Kuyini, 2017, p. 33).

Therefore, neither positivism nor constructivism can explain alone what is required to generate a change that leads to a desired outcome in terms of NNL of biodiversity through the EIA process. This is because it is not possible to have a single truth about the appropriate compensation of biodiversity derived from the application of procedures and methods described in the national legislation, following a single research method as advocated by the positivist paradigm. Neither is it possible to determine the reality which leads to the achievement of no net loss of biodiversity only through the vision of the participants involved in the decision-making process as constructed under the constructivist paradigm, as their behaviours are constrained by the legal context. Instead, a research approach is required that integrates multiple methods, enabling the examination of participants' actual behaviours in their respective roles within the EIA process, the underlying reasons or beliefs driving these behaviours (such as rules or guidelines), and the resulting outcomes (specifically, whether biodiversity NNL is achieved). Thus, a pragmatic paradigm can be used to better reflect the aim of this research (Kivunja & Kuyini, 2017). The pragmatic paradigm allows the establishment of a research question from the detailed description of the context (involving social, political, and environmental conditions); however, the researcher is continually reviewing the question based on their experiences (arising from observations of the behaviour of the actors and stakeholders) and it can be changed to better reflect the types of questions needed to answer the research problem (Creswell & Poth, 2018).

According to Morgan (2014), from a pragmatic paradigm perspective all actions arise from prior beliefs and produce a set of consequences, therefore there is a connection among existing beliefs, actions, and consequences. Prior beliefs are crucial for the perception of the problem being studied and for evaluating the actions that might solve this problem. Thus, prior beliefs play a role in the methods used to answer the research question (Morgan, 2020). This is compatible with grounded theory as a tool for pursuing the research question, in the form of

collecting and analysing data. Morgan (2020, p. 66) indicates that "*GT* [grounded theory] *is a version of qualitative research as a form of pragmatic inquiry*".

3.2 Research approach

This research adopts a pragmatist approach, which emphasises flexibility in methodological choices based on the research questions and the nature of the data. Pragmatism in research supports the use of both qualitative and quantitative methods, often referred to as a mixed-methods approach (Creswell & Clark, 2017). This combination allows the researcher to draw on the strengths of both: quantitative methods provide broad, generalisable insights, while qualitative methods offer deeper, contextual understanding.

In this research, quantitative data are primarily used for sample selection, drawing from secondary data sources such as case study documents (relevant documents from the EIA process). Qualitative data are collected through interviews and focus groups, which are suited for exploring in-depth perceptions and experiences of participants involved in the EIA process. Grounded theory serves as the primary qualitative approach (Strauss & Corbin, 1990), a methodology designed to generate theory from data systematically. Grounded theory is especially useful for this research because it allows the researcher to develop insights and theoretical concepts directly from the participants' experiences (Roudgarmi, 2011). Moreover, this research adopts a mixed methods approach to data collection and analysis, which has been widely used in the field of impact evaluation (Bamberger, 2012; Roudgarmi, 2011; White, 2009, 2011).

The use of grounded theory involves the application of inductive reasoning, where data collection and analysis proceed without preconceived theories (Tie et al., 2019). The researcher allows ideas, concepts, and patterns to emerge from the data itself (Glaser & Strauss, 1967). This bottom-up approach ensures that the findings are grounded in the realities of the participants rather than being shaped by existing frameworks or assumptions (Hayes et al., 2010).

At the same time, the research also incorporates deductive reasoning. This involves testing emerging insights against existing knowledge and literature (Hyde, 2000). By using deductive reasoning, the research ensures that the newly generated concepts are evaluated within the context of broader theoretical frameworks. This combination of inductive and deductive

approaches reflects a key aspect of grounded theory, where constant comparison between data and theory refines both the emerging theory and existing knowledge (Azungah, 2018).

3.3 Research design

For the first research objective, 'to evaluate Chilean policy in relation to international benchmarks', a comparative analysis was employed as the primary research design. This approach involved systematically comparing the existing Chilean policies on biodiversity compensation with established best practice principles for biodiversity offsets identified in the academic and grey literature. The comparative analysis allowed for an evaluation of how well Chilean policies align with international standards and guidelines, highlighting gaps and areas for improvement (see Section 3.4).

For the second objective 'to evaluate Chilean practice in relation to national obligations' (see Sections 3.5, 3.6, 3.7) and the third objective 'to identify the opportunities for improving biodiversity outcomes in Chile' (see Sections 3.5, 3.8), the research design is explained below.

The research design is structured to collect, analyse, and integrate data from both secondary and primary sources, using a combination of grounded theory and mixed methods. The research employs a mixed methods design, combining qualitative and quantitative techniques. Mixed methods are chosen to capitalise on the strengths of each approach, allowing for both breadth (quantitative) and depth (qualitative) in data collection and analysis (Creswell & Clark, 2017). The research follows an exploratory sequential design, where quantitative data guides the selection of participants, while qualitative methods provide the primary insights needed to address the research questions.

This research uses two main types of data: primary data from semi-structured interviews and focus groups with the stakeholders involved in the environmental impact assessment process, and secondary data gathered from the EISs approved from 2015 including all the productive sectors, encompassing all the regions of the country (the case study selection is explained in detail in Section 3.5.1). The first phase of the study involves a quantitative analysis using the case studies selected. The second phase involves qualitative methods using semi-structured interviews with the stakeholders involved in the environmental impact assessment process to examine the Chilean practice, using an inductive reasoning, and subsequently a focus group to identify the opportunities for improving biodiversity outcomes in Chile, using deductive, and

then inductive, reasoning. This iterative process allows the research to contribute new insights while ensuring alignment with established knowledge coming from the interviews (Figure 3.1).

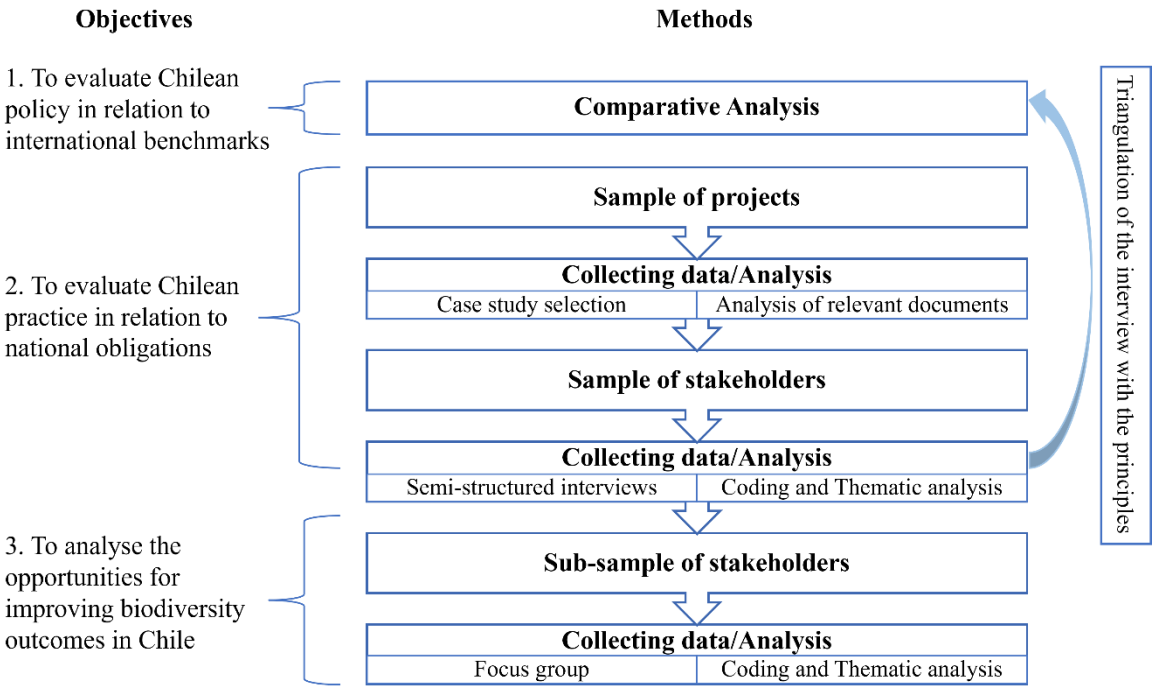

Figure 3.1 Research design framework

3.4 Comparative analysis (objective 1)

3.4.1 Literature Review on international best principles

For the first objective, 'to evaluate Chilean policy in relation to international benchmarks', a search for relevant academic literature was conducted to identify and synthesise international best practice principles for biodiversity offsets. Conducting a comprehensive and well-conducted literature review can be an effective way to consolidate previous research and serves as a robust basis for progressing understanding and promoting theory formation (Snyder, 2019). The literature review was conducted to identify a selection of international biodiversity offsets guidance documents and published literature containing best practice principles for biodiversity offsetting. Although the integration of biodiversity offset strategies within the environmental impact assessment process has become more common (de Witt et al., 2019; Pope et al., 2021), the literature review was conducted to identify the principles that should underpin biodiversity offset planning to evaluate conservation outcomes in general as well as applying to impact assessment.

While some researchers conceptualise practice elements as goals, emphasizing their aspirational nature in guiding conservation outcomes (Maron et al., 2016; Souza et al., 2023), others, however, argue that these elements function as principles, providing structured and normative guidance that informs the implementation of offsetting in a consistent and transparent manner (Brownlie & Treweek, 2018; Bull & Brownlie, 2017; Chee, 2015; Maron et al., 2018; McKenney & Kiesecker, 2010). This thesis adopts the term 'principles' to describe best practice elements, aligning with the approach taken by the Business and Biodiversity Offsets Programme (BBOP, 2012a, 2018a), which defines principles as fundamental rules that underpin effective biodiversity offsetting. Unlike goals, which are typically broader, principles serve as operational guidelines that shape policy frameworks, legal instruments, and decision-making processes (Brownlie & Treweek, 2018; BBOP, 2012c; IFC, 2019). In the context of Chile's EIA System, where regulatory clarity is essential for the effective integration of biodiversity offsets, defining best practice elements as principles ensures a more structured and accountable approach to biodiversity conservation.

Principles serve as fundamental guidelines to ensure the effectiveness of EIA and biodiversity offsetting; however, their conceptual effectiveness in achieving intended conservation goals has been critically examined. For example, Jay et al. (2007) argue that EIA frameworks and methodologies often lack a clear and consistent integration of sustainability principles, resulting in a procedural rather than strategic approach to environmental decision-making. Leknes (2001) highlights that while principles aim to guide decision-making, their effectiveness depends on political will, institutional capacity, and mechanisms for accountability. Building on this, comparative analyses have highlighted the diverse ways in which EIA principles are operationalized in different national contexts, shedding light on both strengths and persistent challenges. Wood (2003) conducted a comprehensive global review of EIA systems, revealing that while many countries adopt similar core principles, their application is often influenced by the strength of legal frameworks, administrative traditions, and levels of stakeholder engagement. Similarly, Arts et al. (2012) suggest that although principles provide a useful framework, their impact varies significantly depending on how they are interpreted and implemented in different jurisdictions.

The online research databases utilised to search for journals and articles included Scopus and Google Scholar, which together represent two of the three largest literature databases, with Web of Science being the third. However, Waltman (2016), notes that Scopus offers broader

coverage than Web of Science, as evidenced by multiple studies. Furthermore, Scopus is acknowledged as one of the most comprehensive indexing databases available (Burnham, 2006). To complement this, Google Scholar was also utilised, as it has been reported to produce significantly different results compared to Scopus and Web of Science (Bar-Ilan, 2008). The inclusion of Google Scholar ensured a broader and more diverse literature review, capturing a wide range of perspectives and sources.

Following Aromataris and Riitano (2014), a search string was created in an iterative process of evolution and refinement, focusing on the question and the key terms articulated in the question, to create a logic concept map. As the literature review seeks to identify best practice principles for biodiversity offsets, the following search string was used to search both databases:

"Biodiversity Offset" AND ("best practice" OR principles OR policy)

Best practices and principles were included to encompass all the values and fundamental guidelines discussed in the literature that influence how biodiversity offsetting should ideally be carried out. This broad inclusion ensures that all types of guiding concepts—whether theoretical principles or practical best practices—are captured. Additionally, policy was also included in the search to make sure that any literature discussing formal rules, procedures, and legal frameworks for biodiversity offsetting was also reviewed. This approach ensures that sources related to regulatory requirements and structured approaches to offset implementation are covered, distinguishing between high-level guiding principles and actionable policy measures that enforce biodiversity offsets in practice.

After conducting database searches, the results were examined to determine which sources would be included or excluded from the review. The rationale for selecting papers was driven by the need to evaluate the alignment of Chilean biodiversity offsetting policy with international principles and practices. Therefore, the review included papers that:

- Address multiple offsetting principles, even if they concentrated on specific aspects, to guide policies or practice.
- Discuss practical or theoretical aspects of implementation and policy-making of the biodiversity offset.
- Contribute to understanding the broader landscape of offset policy and practice.

The inclusion criteria were as follows: (i) materials published in English, (ii) peer-reviewed publications (such as articles and book chapters) as well as grey literature (such as studies and guidance documents from federal agencies or non-government entities such as BBOP), (iii) works published between 2012 and 2024 to capture recent developments in the field, starting with the release of the first Principles on Biodiversity Offsetting by BBOP in 2012, and (iv) literature that emphasised principles, policy, or practice in biodiversity offsetting. Literature analysing biodiversity offsetting from a purely methodological or scientific perspective, without reference to principles, policy, or practice, was excluded to maintain relevance to the research scope. Additionally, works that referenced the BBOP principles or similar sources were also excluded to avoid duplication of information.

The search was initially filtered by title and keywords, and the second filter involved reading the abstracts of each article of interest, with those not meeting the criteria explained above being excluded. Finally, the full text of the selected articles was read, additionally searching for relevant references using a snowballing approach (Wohlin, 2014). This involved focusing on references within useful articles and utilising citation indices to track articles that had cited the paper of interest, ensuring that the most relevant literature was included in the review, ending with a list of 28 articles (see Appendix 1). The flowchart of the methodology for detecting the best practice principles for biodiversity offsetting from the literature review is shown in Figure 3.2.

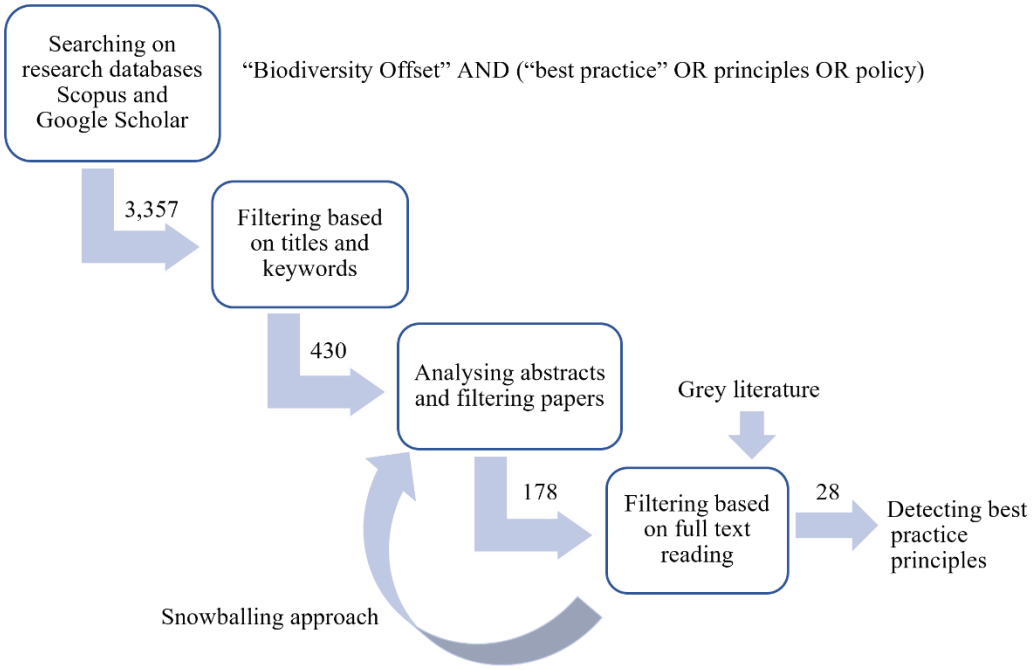

Figure 3.2 Flowchart of the methodology for detecting the best practice principles from the literature review

Grey literature was identified through targeted online searches and manual screening of publications from organisations actively involved in biodiversity offsetting policy and practice, such as the Business and Biodiversity Offsets Programme (BBOP), the Chartered Institute of Ecology and Environmental Management (CIEEM), the International Association for Impact Assessment (IAIA), international NGOs (such as IUCN) and industry bodies engaged in environmental impact assessment such as the International Finance Corporation (IFC) and the World Bank Group (WBG). Organisations were considered relevant based on their recognised role in developing, implementing, or advising on biodiversity offset frameworks. Search strategies involved using combinations of key terms ("biodiversity offset," "no net loss," "mitigation hierarchy", "net gain") with organisation names to identify relevant documents such as policy reports, guidelines, and technical papers. Relevance was assessed based on whether the publication explicitly addressed biodiversity offsetting principles, provided practical guidance on implementation, or informed policy and regulatory frameworks related to no net loss or mitigation measures. A total of six publications were included, selected for their direct relevance to biodiversity offsetting and their contribution to understanding practical applications and implementation challenges.

A total of 40 best practice principles for biodiversity offsets were initially identified through a systematic review of the selected literature. These principles, along with their corresponding textual definitions, were extracted and organised into a matrix in Excel, where each row represented an article and each column a distinct principle. To facilitate comparison, each principle was given a label, typically based on existing terminology in the literature.

During the analysis, overlapping definitions and conceptual similarities among principles became apparent. These overlaps indicated that different authors often described similar ideas using varying terminology. To ensure conceptual clarity and avoid redundancy, principles with equivalent or highly similar definitions were grouped together under a unified category. This process involved comparing definitions side by side, identifying shared core concepts, and consolidating them where appropriate. Through this iterative refinement, the initial set of 40 principles was reduced to a final set of 18 distinct, non-redundant principles, each representing a unique and clearly defined aspect of best practice in biodiversity offsetting.

3.4.2 Developing the analytical framework

An analytical framework provides a systematic way to identify and organise key variables, relationships, and processes, guiding the analysis of data and findings (Michelle, 2007; Yin, 2018). This framework helps researchers draw consistent and meaningful insights by providing a clear set of criteria or perspectives through which data is analysed (Ritchie & Spencer, 2002).

An analytical framework was built to compare Chilean biodiversity offset policy with international best practice principles (Norton, 2009; Salès et al., 2023a). The first step involved conducting an extensive literature review to identify best practice principles on biodiversity offsetting, as stated in Section 3.4.1. The process for developing the analytical framework comprises thematic analysis of the literature following Ward et al. (2009) (see Section 3.7.2). This process involved identifying existing principles explicitly labelled in the literature selected and inductively deriving additional principles from broader discussions by authors. The thematic analysis allows the identification of recurring themes and key components of biodiversity offsetting. Each principle was then systematically associated with the literature from which it was derived, ensuring a robust provenance (see Appendix 1). The resulting framework provides a structured basis for evaluating the alignment between Chilean policy and international best practices.

The second step involved the derivation of assessment criteria as part of the development of the analytical framework, where each principle identified and synthesised from the literature review was translated into measurable indicators that would allow for a structured comparison. This step is essential because it transforms the principles into measurable criteria that can be systematically evaluated and compared across cases or contexts. This process involves conceptualization: each principle was broken down into more specific and observable components (Babbie, 2020). The aim of this framework is to identify gaps, if they exist, or areas for improvement, thereby contributing to the enhancement and development of policy in this domain.

3.4.3 Comparative analysis

The performance of Chilean policy related to biodiversity offsetting was systematically compared against the assessment criteria in the analytical framework. To systematically assess the extent to which Chilean policy aligns with these principles, an analysis was conducted using a structured comparison approach. This involved reading the relevant Chilean policy documents—both guides for biodiversity compensation that have been published— line by line:

1) *Guía para la compensación de biodiversidad en el SEIA* [Guide for Biodiversity Compensation in the EIAS] (SEA, 2014). This National Guide, referenced in the following text as the "2014 guide", is no longer in force and it was superseded by:
2) *Guía para la compensación de biodiversidad en el SEIA* [Guide for Biodiversity Compensation in the EIAS] (SEA, 2022) which is the updated national guide. Additionally, this national guide was complemented with the *Guía metodológica para la compensación de la biodiversidad en ecosistemas terrestres y acuáticos continentales* [Methodological guide for the compensation of biodiversity in terrestrial and inland aquatic ecosystems] (SEA, 2023a) and the *Guía para la Participación Ciudadana Temprana en proyectos que se presentan al Sistema de Evaluación de Impacto Ambiental* [Guide for Early Citizen Participation in projects submitted to the Environmental Impact Assessment System] (SEA, 2023b). Reference to the National Guides in the following text will be made to the "2022-2023 Guides" to include the content of the two complementary guides on compensation methodology and citizen participation (equivalents were not produced for the 2014 guide), as they correspond to the currently updated framework for appropriate compensation of biodiversity in Chile

For each document, a matrix was developed where each row represented a principle from the analytical framework, and each column captured evidence from the policy documents (Table 4.2). Rather than relying on keyword searches alone, each principle was translated into a set of guiding assessment criteria as was explained in section 3.4.2. These guiding criteria were used to manually examine each paragraph of the Chilean policy documents for relevant content. When a relevant excerpt was found, it was recorded in the matrix and categorised according to the corresponding principle. This systematic, manual process ensured that all instances of alignment with the principles were identified, improving the reliability of the comparison.

The 2014 guide and the 2022 guide were developed based on the principles, criteria, and indicators established by the Business and Biodiversity Offsets Programme published in 2012 (BBOP, 2012c), as outlined in those guides (SEA, 2014, 2022), but adapted to the Chilean context. Consequently, whilst Chilean policy will be evaluated against the up-to-date analytical framework for identifying best practice principles for biodiversity offsetting, in recognition that Chilean policy was based on BBOP, the extent to which it aligns with BBOP will also be evaluated.

The comparative analysis was revisited as the final step in the research process of this thesis. This additional step was taken as it enabled the comparison of the interview transcripts from Chapter 6 with the principles outlined in Chapter 4 in case empirical research, inductively derived, identified important biodiversity offset principles missing from the international literature. This approach allowed for triangulation, providing an opportunity to assess conformance with the best practice principles presented in the National Guides through a self-reflective analysis. The results of this analysis are shown in Chapter 8 (see Section 8.1). This approach builds on the literature review acknowledging that there may be gaps in the analytical framework developed from literature alone.

3.5 Sampling strategy (Objectives 2 and 3)

This part of the research was conducted through case study research. A multilevel mixed methods research design (Bamberger, 2012) was carried out to evaluate whether the EIA system has achieved no net loss of biodiversity with the existing tools and procedures along the whole process. For this evaluation, data were collected at the level of the EIA System in Chile, a sample of different investment projects, a sample of stakeholders for the semi-

structured interviews, and a sub-sample of stakeholders for the focus group. At each level, quantitative and qualitative data are collected as shown in Figure 3.3.

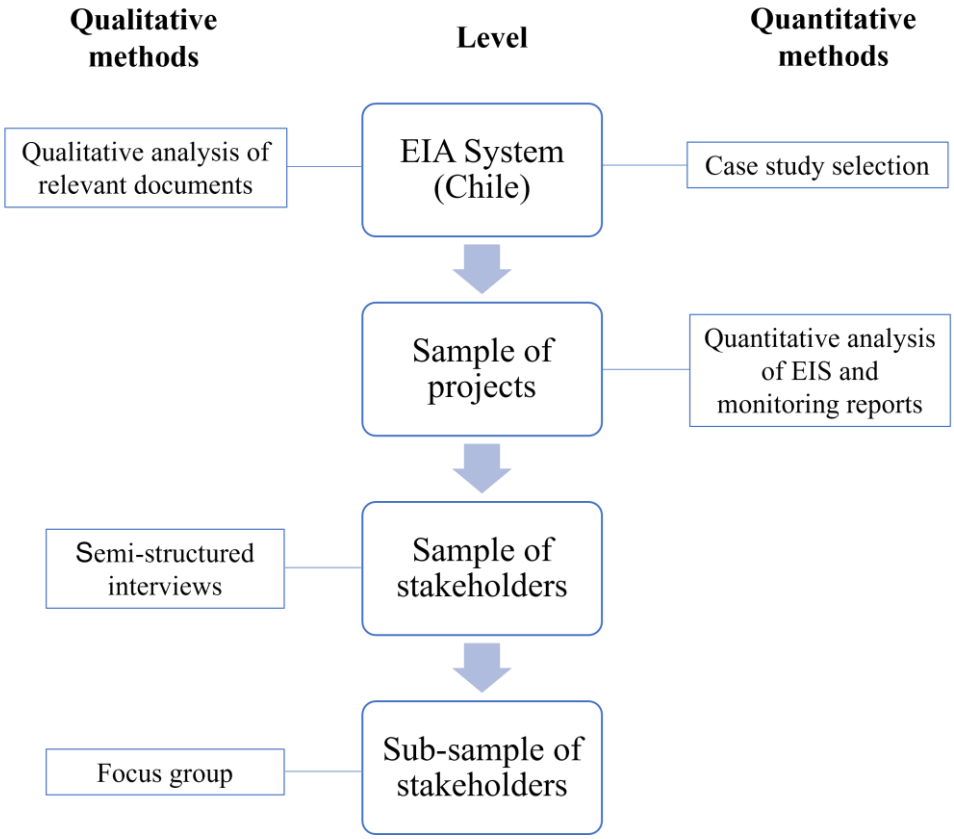

Figure 3.3. Multilevel mixed method design (adapted from Bamberger (2012))

3.5.1 Case study selection

The Chilean practice was evaluated in a first stage through a case study selection. The case studies were selected to identify how the Chilean policy of biodiversity compensation (biodiversity offset) is being applied in practice. To this end, different investment projects subjected to the environmental impact assessment system (EIAS) in Chile were selected, to reflect a wide spectrum of the implementation of environmental regulations in terms of biodiversity compensation.

The case study selection was constrained by the need to obtain a sample large enough to statistically represent practice yet excluding a sufficient number of projects to make the analysis practical and focused on biodiversity impacts. Following the approach of Wood and Jones (1997) for the selection of the case studies, criteria were developed focusing on the biodiversity content of the documents of each project (final EIS, authorisation documentation,

and monitoring reports). The case studies were selected using the criteria presented in Table 3.1.

Table 3.1 Criteria for the selection of EISs for review

Criterion	Restriction	Potential affectation to the practice
Productive sector	Any	Criteria relating to productive sector and region were applied to ensure the final selection was representative enough of the overall cases where environmental impact studies are required in Chile (Wood and Jones, 1997).
Geographical area (region)	Any	The projects are assessed by different authorities depending in which region they are being submitted to the EIAS (Wood and Jones, 1997).
Planning decision	Permission granted	The sample only included approved EISs where the planning permission was already granted by the authority because these projects would generate monitoring requirements which are the focus of the third research question.
Biodiversity compensation required	From 2015	Projects were searched from 2015 onwards to reflect that the recommendations of the 2014 guide (SEA, 2014) on biodiversity compensation should have been incorporated or requested by the authority in the EIS.

Applying these criteria to the EIAs available online initially resulted in 101 development projects reporting biodiversity impacts, corresponding to energy, mining, hydraulic, port, sanitation, housing, transport and others. However, the number of projects decreased when examining monitoring data available for the proposed mitigation, repair and compensation measures related to some of the components of biodiversity affected, with only 31 projects containing monitoring data (for the remaining projects, monitoring has not yet started, or data are not yet available) (Figure 3.4).

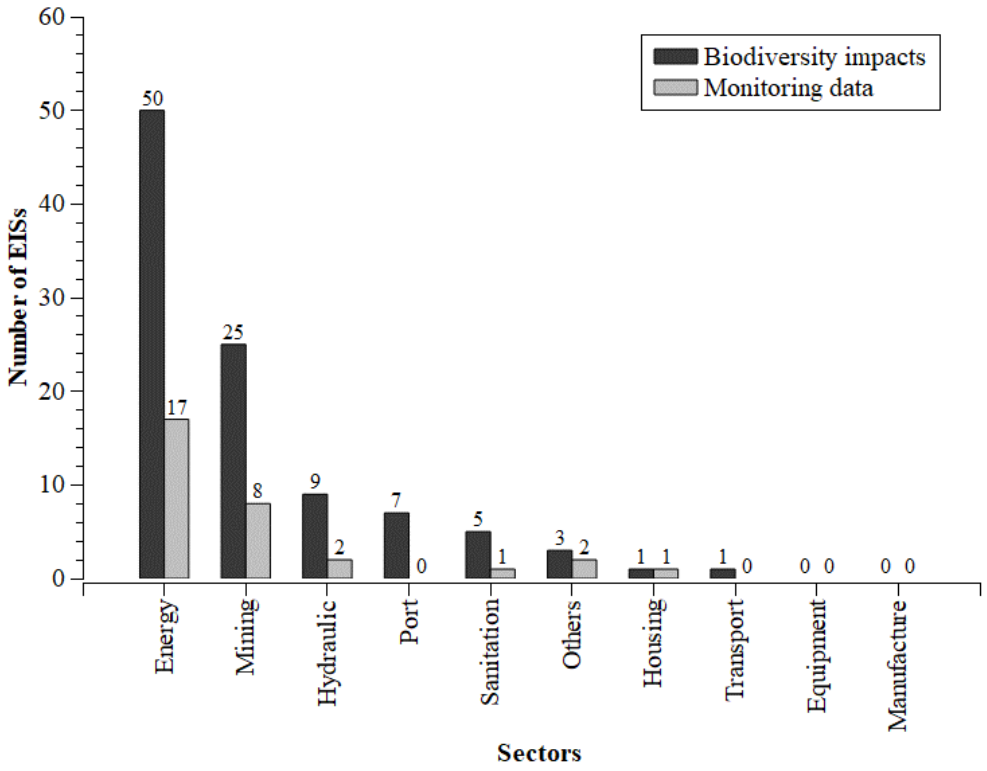

Figure 3.4 Number of EISs approved between 2015-2022 reporting biodiversity impacts per sector. The total number of EISs in each sector is indicated in black, of which the EISs with monitoring data available are represented in grey (as of March 9, 2022)

The 31 projects cover six sectors, with 17 projects corresponding to 'energy', followed by eight from 'mining', two from 'hydraulic', two from 'others', one from 'housing' and one from 'sanitation' (according to the categories indicated by the Environmental Assessment Service) (Table 3.2). These cases are located all over the country, 12 in the north zone, 10 in the centre zone, three in the south zone, with a further six being interregional projects (Figure 3.5). Consequently, the results and conclusions can be extrapolated to represent Chilean practice.

Table 3.2 Case study selected by sector, region and approval date

Nº Case Study	Name of the project	Sector	Region	Approval Date
1	Proyecto Nueva Línea 2x500 kv Charrúa-Ancoa: tendido del primer conductor	Energy	Interregional	30-Jan-2015
2	Línea 2x220 kV Ciruelos-Pichirropulli	Energy	Los Ríos	14-Apr-2015
3	Explotación Minera Oso Negro	Mining	Atacama	18-Jun-2015
4	Proyecto Parque Solar Quilapilún	Energy	Santiago	24-Jun-2015

Table 3.2 Case study selected by sector, region and approval date

Nº Case Study	Name of the project	Sector	Region	Approval Date
5	Proyecto Santo Domingo	Mining	Atacama	8-Jul-2015
6	Candelaria 2030 - Continuidad Operacional	Mining	Atacama	28-Jul-2015
7	Proyecto Parque Eólico Aurora	Energy	Los Lagos	25-Sep-2015
8	Plan de Expansión Chile LT 2x500 kV Cardones – Polpaico	Energy	Interregional	11-Dec-2015
9	Proyecto El Espino	Mining	Coquimbo	12-Jan-2016
10	Mini Central Hidroeléctrica de Pasada Cipresillos	Energy	Rancagua	9-Feb-2016
11	Nueva Línea 2x220 kV Encuentro-Lagunas	Energy	Interregional	8-Mar-2016
12	Ampliación y Modernización Planta Enaex S.A. La Serena	Others	Coquimbo	9-May-2016
13	Parque Fotovoltaico Santiago Solar	Energy	Santiago	4-Jul-2016
14	Planta Desalinizadora de Agua de Mar para la Región de Atacama, Provincias de Copiapó y Chañaral	Sanitation	Atacama	19-Aug-2016
15	Parque Eólico Malleco	Energy	Araucanía	24-Nov-2016
16	Embalse de Regadío Las Palmas	Hydraulic	Valparaíso	19-Dec-2016
17	Proyecto Hidroeléctrico Embalse Digua	Energy	Maule	24-Apr-2017
18	Minicentrales Hidroeléctricas de pasada Aillín y Las Juntas	Energy	Biobío	4-May-2017
19	Minerales primarios Minera Spence	Mining	Antofagasta	4-Aug-2017
20	Infraestructura Complementaria	Mining	Coquimbo	14-Feb-2018
21	Proyecto mejoramiento de la generación, transporte y disposición de residuos arsenicales de división el teniente	Mining	Rancagua	8-Jun-2018
22	Planta Fotovoltaica Santa Rosa	Energy	Santiago	24-Sep-2018
23	Parque Eólico Cabo Leones III	Energy	Atacama	17-Dec-2018
24	Concesión Vial Puente Industrial	Hydraulic	Biobío	17-Dec-2018
25	Mirador de Lo Campino	Housing	Santiago	19-Dec-2018
26	Línea de Transmisión Lo Aguirre - Alto Melipilla y Alto Melipilla – Rapel	Energy	Interregional	21-Dec-2018
27	Nuevas Líneas 2x220 kV entre Parinacota y Cóndores	Energy	Interregional	29-Nov-2019
28	Estudio de Impacto Ambiental Proyecto Salares Norte	Mining	Atacama	18-Dec-2019
29	Estudio Impacto Ambiental Circunvalación Oriente Calama	Others	Antofagasta	17-Sep-2020
30	Nueva Línea Nueva Maitencillo -Punta Colorada -Nueva Pan de Azúcar 2x220 kV, 2x500 MVA	Energy	Interregional	17-Nov-2020
31	Nueva Línea Transmisión 2x220 kV Nueva Pan de Azúcar-Punta Sierra-Centella	Energy	Coquimbo	29-Mar-2021

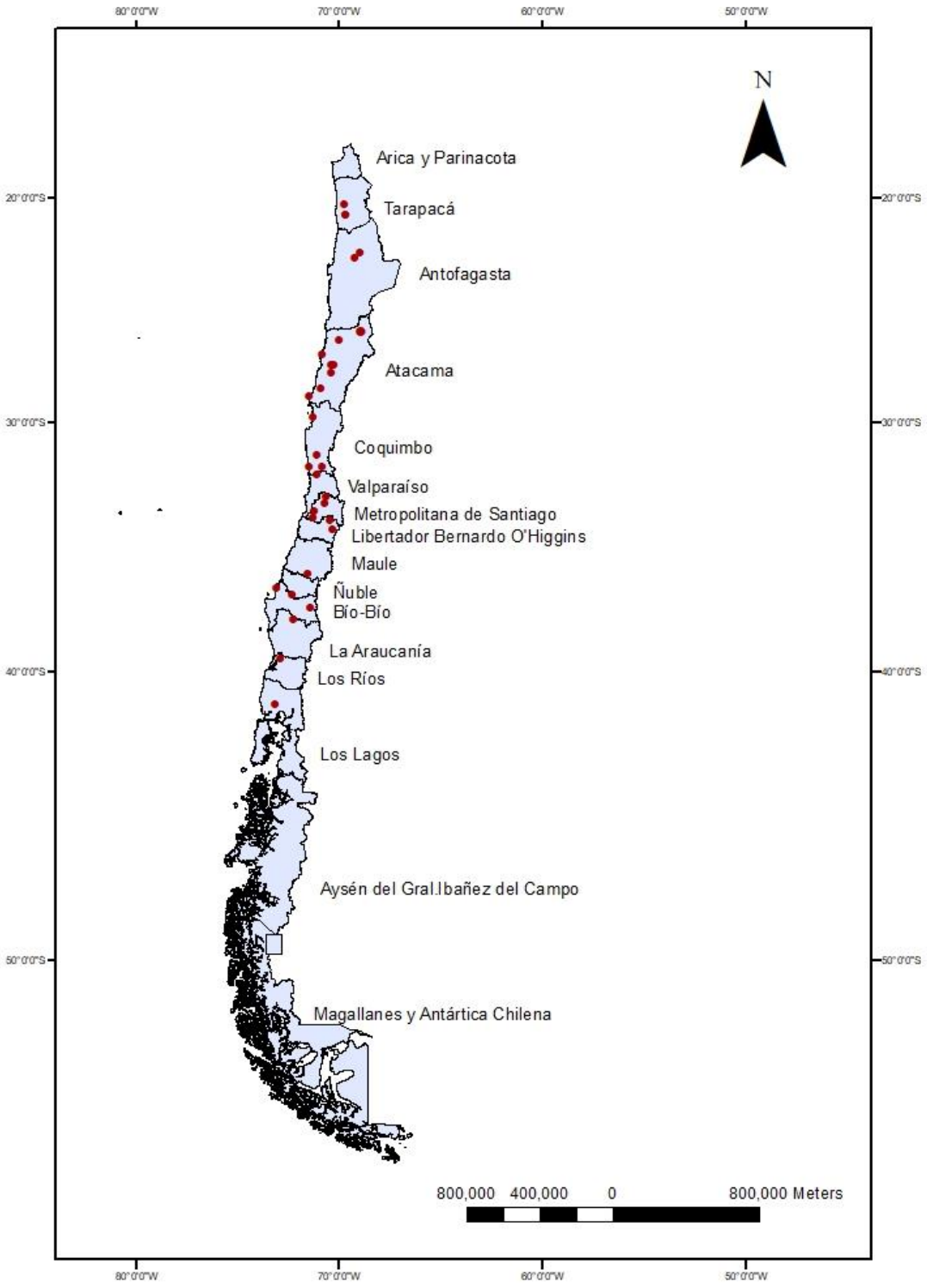

Figure 3.5 Map of Chile and location of the 31 projects selected (red dots)

3.6 Review of relevant documents from the case studies selected (objective 2)

3.6.1 Data collection

This research draws on secondary data sources to provide further insights about the process in which Chile is achieving no net loss of biodiversity, which is part of the second objective 'to evaluate Chilean practice in relation to national obligations'. Secondary data from the review of the case studies, focusing on the biodiversity content of the documents of each project (final EIS, authorisation documentation, and monitoring reports), were used to evaluate the extent to which biodiversity is being protected by the Chilean environmental legislation in practice.

3.6.2 Data analysis

Once the case studies were selected, the available documents (EIS, authorisation documentation, and monitoring reports) were reviewed, to obtain the background information on the cases, regarding type of measures proposed, and details of monitoring such as indicators of biodiversity to be monitored. The final EISs and authorisation documentation were available on the public online database of the Environmental Assessment Service (https://www.sea.gob.cl/) which is the authority in charge of assessing the EISs. The monitoring data were available in the public online database of the Superintendency of the Environment (https://snifa.sma.gob.cl/SeguimientoAmbiental/RCA), the authority in charge of monitoring and follow up.

A database was then created to organise the information extracted from the case studies, including: project name; region; proponent; date of planning permission; sector; mitigation measures; component of biodiversity affected; and type of monitoring. An analysis was performed (as outlined below) to evaluate how the different measures were being proposed, if they were implementing the mitigation hierarchy to achieve biodiversity compensation, and to assess if the monitoring of the measures was being effective.

The mitigation, repair, and compensation measures proposed by the proponents to address biodiversity impacts were reviewed in each of the 31 EISs (one for each case study selected). The number of measures at each level of the mitigation hierarchy (mitigation, repair, and compensation) was counted to analyse the use of the mitigation hierarchy by each development project. To investigate if the measures had been correctly allocated to the right category of the

mitigation hierarchy, all the activities involved in each measure proposed were checked and occasionally reclassified by the researcher following the definitions of the 2014 guide (SEA, 2014) and from the specific National Services with environmental competence in charge of reviewing the impacts related to biodiversity in the EISs (i.e., the *Corporación Nacional Forestal* (National Forest Corporation) (CONAF, 2020), and the *Servicio Agrícola y Ganadero* (Agricultural and Livestock Service) (SAG, 2016, 2021)).

Additionally, the monitoring reports published and available as of the date of the search in 2022 were reviewed for the 31 projects from which the sample of EISs was drawn, to check how the effectiveness of the measures implemented was being evaluated in the reports. The number of completed monitoring reports was determined to assess the level of progress of each project. For each monitoring report, the type of monitoring was identified as well as the indicator that was being monitored, to determine whether they were biodiversity-related, and whether they were measuring biodiversity outcomes, or something else.

3.7 Semi-structured interviews (objective 2)

3.7.1 Data collection

Following the qualitative research approach, semi-structured interviews were conducted with stakeholders involved in the EIA process in Chile, to complement the information gathered from the review of the 31 EISs studied in Section 3.3.6 (case studies selected), as part of the second objective 'to evaluate Chilean practice in relation to national obligations'. This objective aimed at gaining a better understanding of the current implementation of biodiversity compensation in Chile in practice, and to be able to have the opinion of the people who are involved in the process, as a source of evidence on which the case studies rely (Yin, 2018). Out of 31 EISs, a sample of four projects were selected considering the sectors with the greatest number of projects in the country (Figure 3.4) being mining (2 projects), energy (1 project) and hydraulic (1 project), spanning all three geographic zones of Chile (2 in the north, 1 in the centre and 1 in south). The projects are not named to protect the anonymity of the stakeholders involved in the interviews.

This research follows an exploratory and inductive approach (Creswell & Creswell, 2017). The focus is to examine whether the EIA System in Chile, along with other environmental decision-support tools, is achieving a reduction in biodiversity loss, according to the current environmental national legislation. As part of this research, EIA Chilean practice will be

investigated and evaluated, considering the experience, knowledge and perspectives from the stakeholders involved in the EIA process (Gutierrez et al., 2023). For this, semi-structured interviews are an ideal method for gathering information because they allow more flexibility than the traditional interview protocol, and it is possible to obtain open-ended responses from the interviewees, with the opportunity for the interviewer to explore in more detail (Bryman, 2016). This methodology has been employed by numerous authors to gain a deeper understanding of the extent to which Environmental Impact Assessments (EIAs) address various procedural concerns and to evaluate the effectiveness of EIA in relation to these concerns (e.g., de Witt et al., 2019; Dilay et al., 2020; Getty & Morrison-Saunders, 2020; Gutierrez et al., 2023).

The semi-structured interviews were conducted following the steps described in Taherdoost (2022):

(i) Designing an interview protocol, outlining the aim of the study, providing an introduction and detailing ethical considerations.
(ii) Designing the interview questions.
(iii) Pretesting the protocol by conducting a pilot test.
(iv) Selecting the participants.
(v) Preparing the interviews.
(vi) Conducting the interviews.

The interviews consisted of six closed and open-ended questions. The closed questions are designed to examine the extent to which the intended outcomes of biodiversity compensation are being achieved in EIA practice in Chile. The open questions are designed to understand the reasons for the responses to the closed questions. The main framework for biodiversity offsetting in Chile at the time the cases studies were selected, was the 2014 guide (SEA, 2014). However, as in 2022 this guide was updated (SEA, 2022), and a methodological guide (SEA, 2023a) and a citizen participation guide (SEA, 2023b) were published, the updated versions were also discussed among the interviewees. The questions were carefully designed based on the findings from the documentary analysis (see Chapter 5), ensuring they are grounded in evidence and aligned with the objectives of this research. The questions were designed according to the different roles of the stakeholders as set out below.

Questions for Developers/ Environmental Consultants

1. Were you aware of the use of the mitigation hierarchy during the environmental impact assessment of the project?
2. Did you use the Guide for Biodiversity Compensation in the EIAS in this project?
3. Do you think the measures proposed for this project were appropriate to achieve a zero net loss of biodiversity?
4. Why do you think the compensation measures were prioritised over repair measures?
5. Were the measures agreed between the proponent of the project and the consultancy? If yes, what elements are considered to underpin the proposal of the measures?
6. Do you think the monitoring proposed for this project was appropriate in terms of evaluating zero net loss of biodiversity?

Questions for Evaluators/Reviewers/Monitoring officer

1. Were you aware of the use of the mitigation hierarchy during the environmental impact assessment of the project?
2. Did you notice if the Guide for Biodiversity Compensation in the EIAS was used for the project to propose measures?
3. Do you think it is possible to achieve what is established in the Guide for Biodiversity Compensation from the EIAS in terms of zero net loss of biodiversity?
4. Do you think the measures proposed for this project were appropriate to achieve a zero net loss of biodiversity?
5. Why do you think the compensation measures were prioritised over repair measures?
6. Do you think the monitoring proposed for this project was appropriate in terms of evaluating zero net loss of biodiversity?

Participants were selected using purposive and convenience sampling (Barbour, 2001). The former is a strategy to select stakeholders based on their participation in different stages of the EIA process or monitoring post project approval, followed by a snowball strategy (Naderifar et al., 2017), to identify additional individuals that played a role in the assessments but were not specifically cited. The twelve interviews drawn from the four selected case studies were categorised as set out in

Table ***3.3***. Efforts were also made to interview decision makers, but they were not possible to contact.

Table 3.3 Number of participants in the interviews

Stakeholders	Definition	Number of interviewees
Developers (D)	Person responsible for developing and carrying out an investment project	3
Consultants (C)	Professional practitioners (also known as experts, specialists) who provide advice or services in the preparation of EISs	3
Evaluators (E)	Professionals from the Environmental Assessment Service managing the assessment of projects through the reviewing of the EISs	2
Reviewers (R)	People involved in review and evaluation of whether the project complies with the EIA regulations	2
Monitoring officer (M)	People in charge of the monitoring of approved projects	2

In their grounded theory approach to qualitative research, Glaser and Strauss (1967) developed the concept of saturation, as the point in data collection when no new issues or insights arise, and all relevant conceptual categories have been completely identified, examined, and fully covered. Saturation has been the most common guiding principle for evaluating the adequacy of a purposive sample (Morse, 1995), and several authors have attempted to estimate the sample size necessary to achieve saturation (Francis et al., 2010; Guest et al., 2006; Guest et al., 2020; Hennink et al., 2017). The analysis of data saturation in qualitative interviews from the literature suggests that saturation typically occurs at between seven and twelve interviews, capturing 80% to 92% of the total number of codes developed (Guest et al., 2006; Hennink et al., 2017). The extent of data saturation achieved for this research is explained in the results in Section 6.1.

Given the geographic location of the researcher being in the United Kingdom, and the interviewees being in Chile, the interviews were conducted online through Microsoft Teams® 2.0, in Spanish and, following ethical review consistent with the regulations of the University of East Anglia's Science Faculty Research Ethics Committee (see Section 3.9.1), the interviewees remain anonymous. The interviews were video recorded and transcribed to enable coded thematic analysis using NVivo® 14 software. Initial transcripts were produced with Microsoft Teams® 2.0 and were subsequently reviewed for transcription accuracy and revised where necessary.

3.7.2 Data analysis

Thematic analysis is a method used to systematically identify, organise, and interpret patterns of meaning (themes) within a data set, allowing the researcher to understand and make sense of common themes across the data, rather than focusing on unique or individual meanings found in single data items (Braun & Clarke, 2012). The analysis used an inductive coding, allowing the researcher to generate hypotheses and concepts directly from the data, avoiding preconceptions (Tie et al., 2019). As data are gathered from interviews and focus groups, the researcher identifies emerging patterns and constructs theories.

The interviews were coded in English, using simultaneous translation from the transcripts by the PhD student to facilitate the analysis. A thematic analysis was performed using the software programme NVivo® 14 for qualitative data analysis as this is known for being a well-established qualitative data analysis tool (Dilay et al., 2020; Getty & Morrison-Saunders, 2020; Lopezosa, 2020; Rozema & Bond, 2015). It allows the management, analysis, and visualisation of qualitative data and documents systematically and individually.

The thematic analysis process included the following five steps in analysing qualitative data (Braun & Clarke, 2006):

(i) Familiarisation to have deeper insights into the data;
(ii) Generating the initial codes;
(iii) Generating the themes identifying patterns in the codes;
(iv) Reviewing the potential themes; and
(v) Defining and naming themes.

Following the first step, the familiarisation with the data involved transcribing and reviewing the interview recordings. The transcripts were thoroughly read multiple times to gain a deep understanding of the information shared by the interviewees. This stage of familiarisation was crucial for gaining an overview of the data and identifying preliminary patterns.

After familiarisation with the data and critically examining the research objectives and the interview questions, initial codes were generated (the second step). Codes were generated line-by-line, with each code representing a distinct idea, concept, or point of interest in the text. In thematic analysis, a code is a label or a keyword assigned to a segment of data that captures an important aspect of the content, in order to identify and organise the main ideas, seeking

patterns or themes within the data (Braun et al., 2019). As the coding is a recursive process (Braun & Clarke, 2006), the interviews were reviewed and coded multiple times.

Once the codes were generated, they were reviewed to explore any emerging patterns and relationships in the codes. Similar or related codes were grouped together into broader categories to generate themes (the third step), based on their shared relationships and the internal coherence between them (Braun & Clarke, 2012). This stage involved iterative refinement, where codes were reorganised, merged, or split as necessary to ensure clarity and coherence.

As the fourth step indicates, the themes were reviewed and revised in order to answer the research question. Themes were not merely a summary of the codes but represented patterns and key insights that spoke directly to the research question.

Lastly, the emerging themes were reviewed in relation to the entire data set to ensure they accurately reflected the participants' perspectives. The final themes were established and named, and the codebook developed with the final codes and themes (the fifth step).

Throughout the coding process, a reflexive approach was maintained, with regular reflection on how the researcher's perspectives might influence the coding and theme development. This reflexivity was critical to maintaining the rigor and credibility of the analysis.

3.8 Focus groups (objective 3)

3.8.1 Data collection

A focus group discussion is a qualitative data collection approach widely used in conservation research (Morgan, 1997; Nyumba et al., 2018). In this case, it was used to collect views and expert opinions on the assessment process of the EIS, from the perspective of people involved in biodiversity compensation throughout the entire EIA process, as part of the third objective 'to identify the opportunities for improving biodiversity outcomes in Chile'. Focus groups have been conducted before in qualitative research related to environmental policy, especially for investigating the effectiveness of impact assessment systems (e.g., Folkeson et al., 2013; Fonseca et al., 2017; Säynäjoki et al., 2014). In this research, it was performed to explore the results obtained from the interviews, identifying opportunities to improve the biodiversity outcomes considering the findings from the interviews.

Between six and eight participants were targeted, as this number is generally accepted according to Krueger and Casey (2000). The focus group was conducted in person in Santiago, Chile, the 20th of March of 2024, at 10.00 am (CLT), and, following ethical review consistent with the regulations of the University of East Anglia's Science Faculty Research Ethics Committee (see Section 3.9.2), the participants remain anonymous.

Initially, the participants were selected based on judgement sampling, as the specific set of participants needing to be included was already known (stakeholders who participated in the interviews from the case study selection or were identified by these interviewees). The focus group required the participation of at least one representative stakeholder for each stage of the EIA assessment process. However, insufficient representation led to the need to evaluate alternative participants to represent the missing stakeholders. Initially, only two stakeholders from the selected four projects were able to participate. To address this limitation, the search for participants was extended to the remaining 31 projects from the initial case study selection. This process proved challenging, as many individuals involved in the assessment and decision-making for these projects no longer held the same responsibilities or positions. Consequently, representatives from the same institutions, such as the Environmental Assessment Service and the Ministry of Environment, were contacted to fill these gaps. Additionally, individuals involved in the development of the 2014 guide and 2022 guide—while not directly participating in project assessments—were included due to their expertise in biodiversity offsetting. Finally, one NGO stakeholder with experience in citizen participation and project assessment was invited to join the focus group. Although not directly involved in any of the initial 31 projects, their involvement added a valuable NGO perspective to the discussion which would otherwise be missing.

Seven people initially agreed to participate in the focus group. They represented the following stakeholders: environmental consultant, officer from the Environmental Assessment Service, officer from the Environmental Ministry, two specialists who prepared the National Guides, monitoring officer, and one NGO involved in citizen participation. However, due to a number of last-minute withdrawals from the focus group (only two stakeholders attended), supplementary individual interviews were held with five stakeholders who could not attend.

A pre-session preparation was performed to familiarise the moderator with the script, the questions, the group dynamics, and the equipment. The data were collected from the focus group discussion through audio and tape recording and note-taking (Krueger, 1998). The

duration of the meeting was planned to be two hours. The meeting was structured with (i) an introduction (from the moderator and participants, consent and confidentiality, explanation of the rules), (ii) discussion, (iii) introduction to the list of the questions for completion,, (iv) follow up on the themes of the discussion and, finally, (v) a conclusion and acknowledgement to the participants (Nyumba et al., 2018). The focus group was conducted in Spanish and, following ethical review consistent with the regulations of the University of East Anglia's Science Faculty Research Ethics Committee (see Section 3.9.2), the focus group participants remain anonymous. The focus group was video recorded with a camera and transcribed manually from the recording to enable coded thematic analysis using NVivo® 14 software. Initial transcripts were reviewed for transcription accuracy and revised where necessary.

The questions for the focus group were designed based on insights gathered from the semi-structured interviews (see Chapter 6, Section 6.6), ensuring they were evidence-based and aligned with the research objectives. The focus-group discussions then focused on the following questions:

i. There is a tendency to favour compensation measures rather than following the mitigation hierarchy and also to base the mitigation measures on past practice. How do you think stakeholders could be encouraged to prioritise the mitigation hierarchy more effectively?
ii. Evidence indicates that costs dictate mitigation measures, and that there is insufficient expertise to properly design them. What strategies could be implemented to ensure the effective implementation of proposed mitigation measures in practice?
iii. There is considerable uncertainty surrounding the achievement of NNL, failing to implement adequate monitoring systems. How can this be addressed? How might stakeholders work together to improve certainty and ensure that biodiversity losses are effectively compensated for?
iv. The questions elaborated by the agencies involved in the EIA process can include objectives and/or recommendations which then become binding on the developer, but which are incompatible or inconsistent with the National Guides. How can this be addressed?

The supplementary semi-structured interviews were conducted in the days that followed the focus group, asking the participants the same questions discussed in the focus group. The interviews were conducted online through Microsoft Teams® 2.0, in Spanish and, following

ethical review consistent with the regulations of the University of East Anglia's Science Faculty Research Ethics Committee (see Section 3.9.2), the interviewees remain anonymous. The interviews were video recorded and transcribed to enable coded thematic analysis using NVivo® 14 software. Initial transcripts were produced with Microsoft Teams® 2.0, and were then reviewed for transcription accuracy and revised where necessary.

3.8.2 Data analysis

Conducting a focus group with significantly lower attendance than planned—where only two out of seven participants attended—introduces notable limitations, particularly concerning representativeness and the depth of collective discussion. A focus group's primary strength lies in capturing diverse perspectives through dynamic interaction among participants (Morgan, 1997). With only two attendees, the group lacks the diversity needed to fully explore stakeholder views. As the absence of certain stakeholders means that critical insights may be missing, supplementary interviews were conducted with stakeholders who failed to attend the focus group. While this approach ensured that their individual perspectives were captured (Lambert & Loiselle, 2008), interviews lack the interactive context of focus groups, where participants can clarify, challenge, or expand on each other's points. This limits the extent to which collective perspectives can be fully explored and constitutes a significant, although unavoidable, limitation of this research.

Despite these limitations, combining focus group and interview data can offer a pragmatic solution, particularly when participants are unable or unwilling to attend a focus group, offering individual interviews as an alternative (Lambert & Loiselle, 2008). Using a multi-method approach, no distinction was made between the responses from the focus group and those from the supplementary interviews during data analysis. Combining both methods allows for a comprehensive understanding of the topic, ensuring that valuable insights from all participants are included, regardless of the format of data collection (Rees et al., 2003; Taylor, 2005). This flexible approach aligns with the pragmatist research design, prioritising the research objectives over strict adherence to a single method.

The focus group was structured following a deductive reasoning approach, as the main themes to be discussed were identified from the analysis of the interviews in Chapter 6. An inductive approach was then used to identify emerging themes and insights from the coding of the discussions. This iterative process allowed the research to contribute new insights while

ensuring alignment with established knowledge (Azungah, 2018), also acknowledging the limitations of the focus group participation and the integration of supplementary interview data.

The data from the focus group and interviews were coded in English, using simultaneous translation from the transcripts by the researcher (who is a native Spanish speaker) to facilitate the thematic analysis using the software programme NVivo® 14, which is recognised as a widely-used tool for qualitative data analysis (Dilay et al., 2020; Getty & Morrison-Saunders, 2020; Rozema & Bond, 2015). The analysis was conducted following the five steps indicated in Section 3.7.2.

3.9 Ethical considerations

As in all social research, "*the principal ethics consideration should be to ensure the maximum benefit of the research whilst minimising the risk of actual or potential harm*" (ESRC, 2015). Therefore, this research was carried out with ethical procedures to protect, as far as possible, all groups involved in the research, including participants and researchers, following a rigorous protocol reviewed by the University of East Anglia (UEA) Research Ethics Committee (UREC), complying with the ethical principles and standards described in the University's *Research Ethics Policy* (https://my.uea.ac.uk/divisions/research-and-innovation/research-innovation-services/research-support/research-integrity-and-ethics/research-ethics/research-ethics-policy-guidance-notes).

3.9.1 Semi-structured interviews

The protocol was approved by UREC on the 23rd of August 2023 (with approval ID ETH2324-0013). Following this, the participants were contacted by email through an invitation letter informing them about the research objectives and the form the interviews would take. The invitation letter was translated into Spanish by the researcher (Appendix 2). Once they showed interest in participating, a participant information sheet (also translated into Spanish by the researcher, see Appendix 3) was sent to the prospective interviewee to provide more detail about all the characteristics of the study and the use of data collected. Additionally, informed consent (translated into Spanish by the researcher) was sought from those who agreed to participate (Appendix 4) to provide written proof of willingness to participate on the terms set out. Participants were informed that they would be video recorded during the interviews, but anonymity and confidentiality were guaranteed, since no personal information other than their

role would be used. Additionally, they were informed that their participation was voluntary, and they were free to withdraw at any time.

3.9.2 Focus group

The focus group protocol was approved by UREC on the 7th of December 2023 (ID ETH2324-1019). Following this, the participants were contacted by email through an invitation letter informing them about the research objectives and the form the focus group/interviews would take. The invitation letter was translated into Spanish by the researcher (Appendix 5). Once they agreed to participate in the focus group/interview, a participant information sheet was sent to them to provide more detail about all the characteristics of the study and the use of data collected, which was also translated into Spanish by the researcher (Appendix 6). Additionally, informed consent (translated into Spanish by the researcher) was sought from those who agreed to participate (Appendix 7) to provide written proof of willingness to participate on the terms set out. Participants were informed that they would be video recorded during the focus group/interviews, but anonymity and confidentiality were guaranteed, since no personal information other than their role would be used. Additionally, they were informed that their participation was voluntary, and they were free to withdraw at any time.

Chapter 4 Evaluating Chilean policy in relation to international benchmarks (objective 1)

4.1 Introduction

This chapter aims to assess the Chilean biodiversity offset policies against international best practice principles to ensure that the initial framework meets best practice expectations. This first objective directly aligns with the overall aim of evaluating how the EIA system in Chile can best achieve no net loss biodiversity. This assessment serves as a foundational step in understanding whether the challenges in achieving biodiversity outcomes derive from the design of the policies (the framework) or their implementation in practice, providing critical insights into whether the initial structure of the policies align with the expectations of best practices, which is necessary for achieving biodiversity outcomes. This first step also establishes a baseline to evaluate if any observed shortcomings in biodiversity outcomes are a result of inadequate policy design or issues arising during practical application should be explored.

To achieve this aim, a comprehensive synthesis of international best practice principles on biodiversity offsetting was undertaken. This was then used to develop an analytical framework to assess how Chilean policies on biodiversity offsetting align with international best practice principles as a basis for formulating recommendations for improvement, if appropriate. By providing an up-to-date analytical framework benchmarking international best practice expectations for biodiversity offsets, this chapter contributes a framework for evaluation of any national system either in place or under development. It also provides the basis for future research on the effectiveness of biodiversity offset practice in Chile (and potentially elsewhere).

4.2 International best practice principles for biodiversity offsets

The specific area of enquiry in the literature review was to determine best practice principles in biodiversity offsetting. This focus aimed to establish a comprehensive understanding of the foundational guidelines and standards that inform effective offsetting practices. By determining these principles, the literature review sought to achieve the following:

1. Defining core principles: The review explored and synthesised core principles, which are critical for ensuring that biodiversity offsetting practices achieve meaningful

conservation outcomes. These principles were identified through an examination of foundational documents and literature on the topic (Appendix 1).

2. Building an analytical framework: The review aimed to create an analytical framework that would facilitate the comparative analysis of existing policies, such as those in Chile, against international best practice principles. This framework includes clearly defined criteria for assessing the alignment of policies, allowing for a structured and systematic evaluation of biodiversity offsetting guidelines.
3. Comparative analysis: The enquiry aimed to benchmark these principles against the 2014 guide and 2022-2023 guides to determine adherence to best practice. This step involved analysing how these principles are incorporated into real-world offsetting policies and comparing the above guides to theoretical best practices outlined in key literature.
4. Identifying gaps and challenges: The review also focused on highlighting gaps between established best practice principles and the 2014 guide and 2022-2023 guides for biodiversity compensation in Chile, drawing lessons to improve policies and practices for sustainable conservation outcomes in the country.

This Chapter 4 outlines the results of the literature review, structured around the best practice principles that may form part of an effective biodiversity offsetting legal framework (see Section 3.4.2). The literature review results were organized by identifying core principles that are widely recognized as crucial for an effective and sustainable biodiversity offset framework. These principles are drawn from both peer-reviewed studies and guidance documents, such as those by the BBOP, IUCN, IFC and other relevant international organizations. The grouping was structured to highlight how each principle contributes to the overall effectiveness of biodiversity offsetting policies. The synthesis of principles presented below informs the analytical framework, with the emboldened text serving as the basis for developing specific assessment criteria for each principle (as explained in Section 3.4.2).

4.2.1 Adherence to the mitigation hierarchy

The review of literature identified that adherence to the mitigation hierarchy is a fundamental principle in biodiversity offsetting aimed at minimising the negative effects of development on biodiversity (BBOP, 2018a). This sequential approach mandates that attempts should be made to **first avoid impacts through preventive measures** and alternative project designs, applied broadly in environmental impact assessment (Bergès et al., 2020; Brownlie & Treweek, 2018;

de Witt et al., 2019). When complete avoidance is not feasible, steps must be taken to **minimise and reduce impacts as much as possible**, followed by on-site rehabilitation or restoration efforts (Brunetti et al., 2023; Fitzsimons et al., 2014). Only after these measures have been thoroughly pursued should **biodiversity offsets be considered, as a last resort**, to compensate for significant residual impacts (Niner et al., 2017). Proper adherence to this hierarchy is vital to maintaining the integrity and effectiveness of biodiversity conservation efforts, promoting outcomes that benefit both nature and society (Chee, 2015).

4.2.2 Biodiversity Net Gain (BNG)

BNG refers to an approach to biodiversity conservation where developments leave biodiversity in a **measurably better state than before the project began** (CIEEM, 2016). It **goes beyond the principle of no net loss (NNL)**, which aims to balance biodiversity losses from development with equivalent gains elsewhere (BBOP, 2018a; IFC, 2019). BNG explicitly seeks to achieve a **net positive outcome** for biodiversity, ensuring that the total biodiversity is enhanced as a result of human activities (Moilanen & Kotiaho, 2021). Even though NNL has been widely recognized as a guiding principle in biodiversity offsetting (and was the starting point for the aims of this research), emphasising NNL as a minimum requirement for responsible development, aspiring for BNG (Brownlie & Treweek, 2018; BBOP, 2018a; Fallding, 2014; IUCN, 2016; Quétier et al., 2014; Salès et al., 2023b), a growing body of evidence and global consensus suggests that NNL, while valuable, is insufficient to address the scale of biodiversity loss facing the planet (Bull & Brownlie, 2017; Gibbons & Lindenmayer, 2007; Maron et al., 2018; Maron et al., 2020; Moilanen & Kotiaho, 2018). Therefore, a shift toward BNG is not only desirable but necessary. This necessity has led to its recognition and adoption (rather than NNL) as a guiding principle in this research.

4.2.3 Limits to what can be offset

Best practice biodiversity offsets should **incorporate the principle of limits to what can be offset** (BBOP, 2018a; Chee, 2015; de Witt et al., 2019). Projects should **identify biodiversity values that are irreplaceable or vulnerable** and avoid impacts that cannot be offset (CIEEM, 2016; Souza et al., 2023). For irreplaceable or vulnerable values of biodiversity, no loss instead of no net loss should be the requirement (Maron et al., 2021a). The literature also advocates the identification of and adherence to nationally and internationally **acknowledged 'no-go'**

zones (IUCN, 2016) or the definition of 'no go' biodiversity components to delimit acceptable losses (Maron et al., 2021a).

4.2.4 Additionality

Biodiversity offsets must deliver conservation outcomes that are above and beyond what would have occurred without the offset (Souza et al., 2023). This requires delivering measurable net gains for biodiversity that **exceed existing obligations, legal requirements, or ongoing conservation activities** (Fitzsimons et al., 2014; Quétier et al., 2014). Offsets must **provide additional benefits**, which means that the gains from the offsets should exceed the losses, and biodiversity offsets must generate **conservation outcomes that go beyond the results expected without its implementation** (de Witt et al., 2019; Evans, 2023; Jacob et al., 2020; Niner et al., 2017).

4.2.5 Equivalence/Like-for-like

The review identified that one of the most important principles of biodiversity best practice is equivalence (Benabou, 2014). **Offsets should ensure ecological equivalence** and to generate gains that are equivalent to, and thus compensatory for, the ecological losses incurred by development projects (Fitzsimons et al., 2014; Maron et al., 2021a). Offsets must adhere to the **like-for-like or better standard** (de Witt et al., 2019; Fallding, 2014; IFC, 2019), and aim to conserve the same biodiversity values that are being affected (i.e., "in-kind" offsets) (Salès et al., 2023b). However, in instances where the impacted areas are deemed to hold little conservation value, "out-of-kind" offsets may be considered (Benabou, 2014).

4.2.6 Equivalence in size and scale

Biodiversity offsets should be **proportionate in size and scale** to the residual impacts on the affected environmental values (Evans, 2023). This proportionality ensures that the offset effectively addresses **the extent and severity of ecological damage** caused by development projects (Fitzsimons et al., 2014).

4.2.7 Proximity

Biodiversity offset gains should be achieved in close **proximity to the site of development losses** (Bull et al., 2017a). Offset measures must be appropriately located within the same

general area as the impacted site, ensuring they maintain or enhance the affected biodiversity (Fallding, 2014; Quétier et al., 2014). **Proper site selection** and spatial alignment between the impact site and offset measures are crucial to achieving ecological functionality and maintaining biodiversity at the relevant spatial scale (Grimm & Köppel, 2019).

4.2.8 Offsets from earliest stages

Integrating biodiversity and ecosystem services into development planning and EIA should commence at **the earliest stages of project development** to guide sustainable decision-making (Brownlie & Treweek, 2018). Offsets must be **established before any activities** that could cause biodiversity loss begin (de Witt et al., 2019; Fallding, 2014), ensuring that suitable, direct offsets, and potentially other compensatory measures, are in place (Evans, 2023; Fallding, 2014). Offset measures should be timely and structured to achieve biodiversity gains as promptly as possible, ideally before the associated losses occur (Maron et al., 2021a; Souza et al., 2023). This approach helps prevent irreversible damage and mitigates **the potential time lag between the occurrence of impacts and the realization of offset benefits** (Quétier et al., 2014).

4.2.9 Offsets measures must be feasible

Quétier et al. (2014) proposes that offset measures must be feasible, meaning that **project developers are responsibl**e for evaluating the **technical feasibility of achieving the ecological goals** associated with these measures. This is included as a principle because feasibility ensures that proposed offset measures can be realistically carried out within the specific environmental and social context. Without assessing feasibility, there is a risk of proposing measures that are theoretically sound but impractical, leading to ineffective or failed conservation efforts (Lindenmayer et al., 2017). By prioritising feasibility, project developers can ensure that their offset measures align with broader conservation priorities and goals (Pilgrim et al., 2013). Including feasibility as a principle in biodiversity offset measures is vital for ensuring that these initiatives are practical, effective, and capable of delivering real conservation outcomes.

4.2.10 Long-term outcomes

Best practice principles in biodiversity offsets should incorporate the principle of long-term outcomes (BBOP, 2018a; de Witt et al., 2019; Souza et al., 2023). Biodiversity offsets must be designed to **endure for as long as the residual impacts of development occur** (Fallding, 2014), and the benefits of offsets must be delivered for the duration of these impacts, ideally in perpetuity (Grimm & Köppel, 2019; WBG, 2016), focusing on **achieving long-term strategic outcomes** (Fitzsimons et al., 2014). Additionally, **the duration of offset measures must be proportional** to the impacts they are addressing (Quétier et al., 2014).

4.2.11 Precautionary approach

Best practice principles in biodiversity offsetting should include the precautionary approach. The **precautionary approach should be used in situations where the effects of development on biodiversity and ecosystem services are uncertain**, especially when there is insufficient information to rule out the possibility of unacceptable, irreversible, or non-offsetable impacts (Brownlie & Treweek, 2018; de Witt et al., 2019). It is crucial to anticipate and **address foreseeable uncertainties and risks** that could affect the achievement of 'no net loss' in the planning of offsets (Chee, 2015; Evans, 2023). Applying established methods to include contingencies in calculations of biodiversity losses and gains should compensate for potential risks and account for the time lag between the occurrence of losses and the full realization of gains (CIEEM, 2016). It is essential to effectively **manage and address the risks associated with the potential failure of the offset** (Fitzsimons et al., 2014; Simmonds et al., 2022).

4.2.12 Ecosystem approach

In the specific context of biodiversity offsetting, the literature suggests that best practice should incorporate the ecosystem approach (BBOP, 2018a). This approach emphasizes that biodiversity offsets should align with **landscape and ecosystem strategies**, integrating the ecosystem perspective throughout all stages of the mitigation hierarchy (de Witt et al., 2019; IFC, 2019; IUCN, 2016), **allowing ecological changes to be assessed at spatial and temporal scales** (Brownlie & Treweek, 2018). Establishing distinct net **outcome goals for ecosystems, species, and genetic diversity** will ensure that all critical aspects of biodiversity are adequately addressed (Maron et al., 2021b).

4.2.13 Adaptive management and monitoring

A comprehensive **monitoring and evaluation system should be developed**, based on clear indicators to track progress and enable corrective actions as needed for achieving NNL (Chee, 2015; Souza et al., 2023). Offset measures must have **performance-based ecological goals**, accompanied by defined protocols to assess both their effectiveness (i.e., whether actions were taken) and efficacy (i.e., whether those actions achieved the desired results) (Quétier et al., 2014). Clearly **defining responsibilities and establishing mechanisms** for monitoring implementation is essential (Brownlie & Treweek, 2018).

4.2.14 Cumulative, direct and indirect impacts

The literature indicates that **cumulative, direct, and indirect impacts should be considered** to effectively manage environmental impacts (de Witt et al., 2019). Comprehensive impact assessments should be conducted that evaluate not only the direct impacts of a project but also its indirect and cumulative effects. This involves analysing **how a project may influence surrounding ecosystems, communities, and resources over time** (de Witt et al., 2019; IUCN, 2016).

4.2.15 Compliance with monitoring and enforcement

Oversight and compliance are vital (de Witt et al., 2019). According to Niner et al. (2017), a third party or regulatory body should maintain oversight to ensure adherence to biodiversity offset requirements. Additionally, it is important to identify and implement the **necessary legal, institutional, and financial frameworks** to ensure the long-term governance of all mitigation actions and offsets (IUCN, 2016). This includes ensuring that offsets are **enforceable and auditable**, documented in sufficient detail, and governed by transparent arrangements that allow for effective measurement, monitoring, and enforcement (de Witt et al., 2019; Fallding, 2014). Finally, effective management and governance are imperative to achieve successful biodiversity outcomes (Evans, 2023).

4.2.16 Participatory and transparent approach

Best practice biodiversity offsetting should incorporate **stakeholder rights, values, and dependencies** on biodiversity and ecosystems for meaningful and fair decision-making, including throughout the EIA process, ensuring that all voices are heard and considered

(Brownlie & Treweek, 2018). Projects impacting biodiversity and ecosystems should facilitate **effective participation of stakeholders** in evaluating, selecting, designing, implementing, and monitoring biodiversity offsets (BBOP, 2018a). Early engagement is crucial to foster collaboration, build trust, and integrate diverse perspectives into offset strategies (CIEEM, 2016; Souza et al., 2023). By involving stakeholders in these processes, benefits can be fairly shared, and project outcomes can align better with community values and needs (Fallding, 2014). The literature also reveals that **transparency in planning, implementing, and reporting on biodiversity offsets is key** (de Witt et al., 2019; Evans, 2023). Clear communication regarding the design, implementation, and outcomes of the offset fosters trust among stakeholders and helps to ensure that everyone understands their roles and contributions (Fallding, 2014).

Locally, the Regional Agreement on Access to Information, Public Participation and Justice in Environmental Matters in Latin America and the Caribbean, commonly referred to as the Escazú Agreement, is a multilateral treaty that advances environmental rights and governance in the region (ECLAC, 2018). Adopted in 2018 in Escazú, Costa Rica, the agreement entered into force on April 22, 2021, and is the first treaty in Latin America and the Caribbean that explicitly incorporates provisions to ensure the rights of access to information, public participation, and access to justice in environmental matters.

4.2.17 Support evidence-based approaches

Offsets should **rely on robust environmental information** and knowledge to deliver conservation outcomes that are measurable and sustainable (Brownlie & Treweek, 2018; BBOP, 2018a). Science-based approaches that consider both environmental and social impacts—including the effects of mitigation measures on local livelihoods—are essential to developing responsible and effective offset strategies (IUCN, 2016). The process of designing and implementing biodiversity offsets should be well-documented, drawing from established ecological principles and scientific rigor (Fallding, 2014). **Integrating sound science with traditional knowledge** ensures that offsets are contextually appropriate and ecologically effective (BBOP, 2018a).

4.2.18 Equity and rights-based approach

A biodiversity offset should be **designed and implemented in an equitable manner**, ensuring that the rights and responsibilities, risks, and rewards associated with the project and its offset are shared fairly among all stakeholders (BBOP, 2018a). Thus offsets should respect legal and customary arrangements and **prioritize the rights of indigenous peoples and local communities** recognized at both international and national levels (BBOP, 2018a; IUCN, 2016). There is a need to ensure that all community engagement follows a **free and prior informed consent (FPIC) approach**, referring to the right of indigenous peoples to give or withhold their consent for any action that would affect their lands, territories or rights (IFC, 2012).

4.3 Analytical framework

Given the increasing understanding of biodiversity offsets internationally, there is a need to assess their effectiveness and identify best practices. In this regard, an analytical framework is essential for comparing national biodiversity offset policies with established global best practice principles (Norton, 2009; Salès et al., 2023a). Such a framework allows for a systematic evaluation of policies, offering a structured approach to measure how well a country's offset policies align with international standards.

This framework can help identify gaps and areas for improvement by examining the 18 key principles identified from the literature review (Section 4.2), to assess the extent to which national practices align with biodiversity offset policies and practice (

Table ***4.1***). As the analytical framework is designed to assess biodiversity offset policies within the context of global best practices, it should be applicable for use in other countries as well. By establishing a structured set of criteria that aligns with internationally recognised standards defined from the literature reviewed, this framework offers a universal tool for evaluating and comparing offset policies across diverse regulatory contexts.

Table 4.1 Analytical framework for evaluating policies related to biodiversity offsetting following standard criteria from the literature

Principle	Assessment Criteria	References
1. Adherence to the mitigation hierarchy	a) First avoid impacts b) Minimise and reduce impacts as much as possible c) Biodiversity offsets as a last resort	BBOP (2018); Benabou (2014); Bergès et al. (2020); Brownlie and Treweek (2018); Brunetti et al. (2023); de Witt et al. (2019); Fitzsimons et al. (2014); Niner et al. (2017)
2. Biodiversity net gain (BNG)	a) Beyond NNL b) Measurable gains c) Net positive outcome	IUCN (2016); Brownlie and Treweek (2018); Bull and Brownlie (2017); CIEEM (2016); Fallding (2014); Quétier et al. (2014); (Salès et al., 2023b)
3. Limits to what can be offset	a) Incorporate limits to offsetting b) Identify irreplaceable or vulnerable biodiversity c) Define 'no-go' zones	BBOP (2018); IUCN (2016); CIEEM (2016); Chee (2015); de Witt et al. (2019); Maron et al. (2021a); Souza et al. (2023)
4. Additionality	a) Offsets must deliver additional benefits b) Exceed existing obligations or legal requirements c) Outcomes beyond the results expected without offset	de Witt et al. (2019); Evans (2023); Fitzsimons et al. (2014); Jacob et al. (2020); Niner et al. (2017); Quétier et al. (2014); Souza et al. (2023)
5. Equivalence/Like-for-like	a) Offsets must ensure ecological equivalence b) Like-for-like standard	IFC (2019); de Witt et al. (2019); Fallding (2014); Fitzsimons et al. (2014); Maron et al. (2021a)
6. Equivalence in size and scale	a) Proportionate in size and scale b) Correspond to the extent of biodiversity damage	Evans (2023); Fitzsimons et al. (2014)
7. Proximity	a) Proximity to the impact site b) Proper site selection	Bull et al. (2017a); Grimm and Köppel (2019)
8. Offsets from earliest stages	a) Early integration into planning b) Establish offsets before activities begin c) Addressing potential time lags	Brownlie and Treweek (2018); de Witt et al. (2019); Fallding (2014); Maron et al. (2021a); Quétier et al. (2014); Souza et al. (2023)
9. Offsets measures must be feasible	a) Feasibility of offset measures b) Project developers' responsibility	Quétier et al. (2014)
10. Long-term outcomes	a) Long-term strategic conservation goals b) Offset must endure for as long as the residual impacts c) Proportionality in duration	BBOP (2018); Fallding (2014); Fitzsimons et al. (2014); Quétier et al. (2014)
11. Precautionary approach	a) Precautionary principle b) Account for uncertainties and risks c) Anticipating and managing risks and uncertainties	Brownlie and Treweek (2018); Chee (2015); de Witt et al. (2019); Evans (2023); Fitzsimons et al. (2014); Simmonds et al. (2022)
12. Ecosystem approach	a) Integrate ecosystem strategies b) Net outcome for key biodiversity elements c) Ecological changes assessed at spatial and temporal scales	BBOP (2018); IFC (2019); IUCN (2016); Brownlie and Treweek (2018); de Witt et al. (2019); Maron et al. (2021a)

Table 4.1 Analytical framework for evaluating policies related to biodiversity offsetting following standard criteria from the literature

Principle	Assessment Criteria	References
13. Adaptative management and monitoring	a) Performance-based ecological goals b) Monitoring and evaluation system c) Clear responsibilities and monitoring mechanisms	Brownlie and Treweek (2018); Chee (2015); Quétier et al. (2014); Souza et al. (2023)
14. Cumulative, direct, and indirect impacts	a) Assessing cumulative, direct and indirect impacts b) Broader effects on environment considerations	de Witt et al. (2019); IUCN (2016)
15. Compliance with monitoring and enforcement	a) Oversight and compliance b) Legal and institutional frameworks c) Enforceable and auditable	IUCN (2016); de Witt et al. (2019); Evans (2023); Fallding (2014); Niner et al. (2017)
16. Participatory and transparent approach	a) Stakeholder engagement b) Effective participation c) Transparency and communication	BBOP (2018); Brownlie and Treweek (2018); de Witt et al. (2019); Evans (2023); Fallding (2014)
17. Support evidence-based approaches	a) Rely on robust environmental information b) Integrating science with traditional knowledge	BBOP (2018); IUCN (2016); Brownlie and Treweek (2018); Fallding (2014)
18. Equity and rights-based approach	a) Equitable design and implementation of offsets b) Prioritise indigenous rights and local communities c) Free, Prior, and Informed Consent (FPIC)	BBOP (2018); IFC (2012); IUCN (2016); Fallding (2014)

4.4 Evaluating Chilean policy using the analytical framework

The current national policies related to biodiversity offsetting (see Section 3.4.3 for the detail of the Chilean policies) were assessed against the assessment criteria from the analytical framework (

Table ***4.1***). The performance of the national policy was assessed as being either fully covered, partially covered, or absent (not covered) (following the scoring system adopted by Wood (2003), in his comparative analysis of seven EIA systems) as shown in Table 4.2. If national policies meet all the assessment criteria outlined in Table 4.1, this demonstrates that the requirements for that particular principle are fully addressed in the policy. Meeting at least one criterion (but not all) indicates partial compliance with the principle, while failing to meet any criteria indicates that the principle is not incorporated into the policy.

Table 4.2 shows the performance of the 2014 guide and the updated 2022-23 guides. Although the 2014 guide is now obsolete and no longer in force, it is included to illustrate the evolution and progress in guideline development over time, recognising that it was the guide in force for some of the EISs analysed in chapter 3. However, where citations are provided in Table 4.2 to justify assessment criteria compliance, these cite only the relevant pages of the 2022-23 guides. Additionally, as the Chilean policy is based on the BBOP standards of 2012 (BBOP, 2012a) (see Section 3.4.3), they are highlighted in the table to determine consistency with them.

Table 4.2 Performance of Chilean policy against international best practice principles for biodiversity offsets

Principle	Chilean guide (2014)	Chilean guides (2022-2023)	Assessment Criteria	Observations
1. Adherence to the mitigation hierarchy	●	●	a) First avoid impacts b) Minimise and reduce impacts as much as possible c) Biodiversity offsets as a last resort	a) Both the 2014 and 2022-2023 guides present avoidance as the first step of the mitigation hierarchy (SEA, 2022, p. 23). b) Both the 2014 and 2022-2023 guides indicate minimisation and repair (restore one or more of the components of the environment to a quality similar to that which existed before the impact), before considering compensation (offsets) (SEA, 2022, p. 23). c) Both the 2014 and 2022-2023 guides state the residual impacts must be compensated only after avoid, minimise and repair have been considered (SEA, 2022, p. 23).
2. Biodiversity net gain (BNG)	◗	◗	a) Beyond NNL b) Measurable gains c) Net positive outcome	a) Both the 2014 and 2022-2023 guides point out that the goal of appropriate biodiversity offsets is to achieve zero net loss (no net loss) or even a net gain in biodiversity. (SEA, 2022, p. 19). However, the central principle of appropriate biodiversity compensation in Chile is no net loss rather than net gain (SEA, 2022, p. 19). b) Although both the 2014 and 2022-2023 guides stipulate quantifying the losses and gains of

Principle	Chilean guide (2014)	Chilean guides (2022-2023)	Assessment Criteria	Observations
				biodiversity (quantification of the residual impacts to obtain a net loss of zero or, preferably, a net gain of biodiversity (SEA, 2022, pp. 19-20)), the methods for the quantification were not outlined until the methodological guide was published in 2023 (SEA, 2023a). c) Both the 2014 and 2022-2023 guides establish that "the appropriate compensation of biodiversity can be defined as achieving measurable biodiversity conservation outcomes that compensate for what has been impacted" (SEA, 2022, p. 19), but they do not refer to net positive outcomes.

Key: Level of adoption of the principles in the 2014 guide and 2022-2023 guides: ●, fully covered; ◗, partially covered; ○, absent. Principle included in the BBOP principles. Principle not included in the BBOP principles.

Table 4.2 Performance of Chilean policy against international best practice principles for biodiversity offsets

Principle	Chilean guide (2014)	Chilean guides (2022-2023)	Assessment Criteria	Observations
3. Limits to what can be offset	◗	●	a) Incorporate limits to offsetting b) Identify irreplaceable or vulnerable biodiversity c) Define 'no-go' zones	a) Both the 2014 and 2022-2023 guides incorporate the existence of limits to compensation (SEA, 2022, p. 25). b) Both the 2014 and 2022-2023 guides state that "the limits for biodiversity offsets are determined by the conditions of irreplaceability and vulnerability" (SEA, 2022, p. 25). c) Although neither the 2014 nor the 2022-2023 guides make explicit the concept of 'no go' biodiversity components or areas, the methodological guide (2023a) delivers a methodology to determine the offsetability of the biodiversity (landscapes, ecosystems, biotopes, habitats, communities, or species), recognising that not all biodiversity can be compensated (SEA, 2023a, pp. 36-37).
4. Additionality	●	●	a) Offsets must deliver additional benefits b) Exceed existing obligations or legal requirements	a) According to both the 2014 and 2022-2023 guides "the results derived from the appropriate compensation actions must be additional to what would have occurred at the site if the measure had not been taken. That is, these actions must result in an improvement in the condition of biodiversity

Principle	Chilean guide (2014)	Chilean guides (2022-2023)	Assessment Criteria	Observations
			c) Outcomes beyond the results expected without offset	obtained in the offset scenario compared to the no offset scenario" (SEA, 2022, p. 24). b) Both the 2014 and 2022-2023 guides state that in order to be considered an additionality, the fulfilment of pre-existing obligations cannot be considered to be additional (SEA, 2022, p. 25). c) Both the 2014 and 2022-2023 guides establish that "appropriate compensation requires measures that aim to produce an alternative and equivalent positive effect with the goal of zero net loss or, preferably, a net gain of biodiversity (SEA, 2022, p. 20).

Key: Level of adoption of the principles in the 2014 guide and 2022-2023 guides: ●, fully covered; ◗, partially covered; ○, absent. Principle included in the BBOP principles. Principle not included in the BBOP principles.

Table 4.2 Performance of Chilean policy against international best practice principles for biodiversity offsets

Principle	Chilean guide (2014)	Chilean guides (2022-2023)	Assessment Criteria	Observations
5. Equivalence/ Like-for-like	●	●	a) Offsets must ensure ecological equivalence b) Like-for-like standard	a) Both the 2014 and 2022-2023 guides state that "for a compensation measure to be acceptable, it is necessary to demonstrate ecological equivalence" (SEA, 2022, p. 26). b) A surrogate for like-for-like standard is established in both the 2014 and 2022-2023 guides, seeking "to ensure that biodiversity elements affected by a project or activity are compensated on the ground by elements of similar characteristics, type, nature, quality and function" (SEA, 2022, p. 24).
6. Equivalence in size and scale	○	●	a) Proportionate in size and scale b) Correspond to the extent of biodiversity damage	a) The 2014 guide does not refer to the equivalence related to size and scale. In contrast, the methodological guide (2023a) delivers the methodology to define the area to compensate depending on the condition of the biodiversity (SEA, 2023a). b) The 2014 guide does not mention the extent of biodiversity damage, but the methodological guide (2023a) indicates that "the area of compensation accounts for the extent and quality of biodiversity lost" (SEA, 2023a, p. 66).
7. Proximity	◗	●	a) Proximity to the impact site b) Proper site selection	a) Both the 2014 and 2022-2023 guides consider the proximity to the impacted area, but the 2022 guide explicitly states that "compensation measures aim to improve the quality of biodiversity at another site, ideally close to the area of influence of the component" (SEA, 2022, p. 18). The National Guides refer to "ideally close" and not just "close", because it is more relevant that "the offset site is in the same ecosystem type as the site impacted by the project, so that the same key biodiversity components affected by the project are maintained or can be established" (SEA, 2022, p. 44). Therefore, the compensation site could not be close to the impact site, but it would be compensating the same ecosystem. b) Both the 2014 and 2022-2023 guides contemplate a proper site selection seeking to ensure "that the area is adequate to compensate the residual impacts" (SEA, 2022, p. 43).

Key: Level of adoption of the principles in the 2014 guide and 2022-2023 guides: ●, fully covered; ◗, partially covered; ○, absent. Principle included in the BBOP principles. Principle not included in the BBOP principles.

Table 4.2 Performance of Chilean policy against international best practice principles for biodiversity offsets

Principle	Chilean guide (2014)	Chilean guides (2022-2023)	Assessment Criteria	Observations
8. Offsets from earliest stages	◗	◗	a) Early integration into planning b) Establish offsets before activities begin c) Addressing potential time lags	a) Both the 2014 and 2022-2023 guides recommend "to incorporate offsets early in project planning" (SEA, 2022, p. 30). b) Offsets are not considered before the start of activities in either the 2014 or 2022-2023 guides. c) The time lag between the impacts and offsets are considered in both the 2014 and 2022-2023 guides, stating that "the implementation of the compensation measure should occur as early as possible during project implementation" (SEA, 2022, p. 44).
9. Offsets measures must be feasible	◗	◗	a) Feasibility of offset measures b) Project developers' responsibility	a) It is stated in both the 2014 and 2022-2023 guides that "the theoretical and practical feasibility of carrying out an appropriate compensation measure should be assessed" (SEA, 2022, p. 27). b) Both the 2014 and 2022-2023 guides indicate that "compliance with the guide is the exclusive responsibility of the project developer" (SEA, 2022, p. 15), however, it does not explicitly specify the developers' responsibility for the feasibility of offsets.
10. Long-term outcomes	◗	●	a) Long-term strategic conservation goals b) Offset must endure for as long as the residual impacts c) Proportionality in duration	a) In terms of long-term goals, both the 2014 and 2022-2023 guides require that "the [compensation] site is adequate, in terms of its administration and management, to ensure that biodiversity elements persist, and their attributes (viability over time) are maintained or enhanced beyond the life of the investment project" (SEA, 2022, p. 44). Also, the methodological guide (2023a) highlights that the compensation site must be protected by a formal mechanism that ensures the safeguarding of the existing natural heritage in perpetuity (SEA, 2023a, p. 69). b) The 2014 guide does not mention that offsets must endure for as long as the residual impacts. Only the 2022 guide specifies that "[the measure] should be maintained in the long term, considering the duration of the residual impacts" (SEA, 2022, p. 19). c) The 2014 guide does not mention proportionality in duration. However this is considered in the methodological guide (SEA, 2023a).

Key: Level of adoption of the principles in the 2014 guide and 2022-2023 guides: ●, fully covered; ◗, partially covered; ○, absent. Principle included in the BBOP principles. Principle not included in the BBOP principles.

Table 4.2 Performance of Chilean policy against international best practice principles for biodiversity offsets

Principle	Chilean guide (2014)	Chilean guides (2022-2023)	Assessment Criteria	Observations
11. Precautionary approach	○	◗	a) Precautionary principle b) Account for uncertainties and risks c) Anticipating and managing risks and uncertainties	a) Both the 2014 and 2022-2023 guides fail to mention the precautionary principle. b) Neither the 2014 nor the 2022-2023 guides specify a way to account for uncertainties and risks. Alternatively, they recommend that "given the uncertainty of predictions, it is important to be conservative in calculations in order to ensure zero net loss" (SEA, 2022, p. 41). c) The 2022 guide mentions that "the metric includes a risk factor associated with the delay in achieving the results of the compensation measures", indicating some form of managing risks and uncertainties (SEA, 2022, p. 37), which is not included in the 2014 guide.
12. Ecosystem approach	◗	●	a) Integrate ecosystem strategies b) Net outcome for key biodiversity elements c) Ecological changes assessed at spatial and temporal scales	a) The concept of an ecosystem approach is a binding principle in the Chilean legislation as a party of the Convention on Biological Diversity (CBD). It is delineated within the introduction to both the 2014 and 2022-2023 guides as the main framework for addressing the objectives set forth by the CBD (SEA, 2022, p. 10). However, the metrics to quantify biodiversity based on this concept are in the methodological guide, referenced to the key biodiversity components (SEA, 2023a). b) The 2014 guide does not mention net outcomes for key biodiversity elements. On the other hand, the 2022 guide state that "to consider different levels of biodiversity for the compensation, the characterisation of key biodiversity components at the species, community/habitat and ecosystem/landscape levels must be considered… This characterisation should be carried out for both the site to be negatively impacted and the compensation site(s)" (SEA, 2022, p. 41). c) The 2014 guide does not mention the assessment of ecological changes at spatial and temporal scales. The spatial and temporal scales are considered in the methodological guide (SEA, 2023a).

Key: Level of adoption of the principles in the 2014 guide and 2022-2023 guides: ●, fully covered; ◗, partially covered; ○, absent. Principle included in the BBOP principles. Principle not included in the BBOP principles.

Table 4.2 Performance of Chilean policy against international best practice principles for biodiversity offsets

Principle	Chilean guide (2014)	Chilean guides (2022-2023)	Assessment Criteria	Observations
13. Adaptative management and monitoring	◗	●	a) Performance-based ecological goals b) Monitoring and evaluation system c) Clear responsibilities and monitoring mechanisms	a) The 2022 guide indicates that all biodiversity parameters to be monitored should be listed, to demonstrate the success of the offset measures, and adds that "the developer must consider and commit to adaptive management of the sites where compensation is considered, in case monitoring shows that the expected results are not being obtained" (SEA, 2022, p. 46). Reference to adaptative management is missing from the 2014 guide. b) In both the 2014 and 2022-2023 guides there is a requirement to establish a monitoring plan and the means of verification of the measure (SEA, 2022, p. 46). c) The responsibilities and monitoring mechanisms are indicated in Law Nº19,300 (1994) and Law Nº20,417 (2010) of the Environment. This means the assessment criterion is met irrespective of the content of the National Guides.
14. Cumulative, direct, and indirect impacts	○	○	a) Assessing cumulative, direct and indirect impacts b) Broader effects on environment considerations	a) Although direct and indirect impacts are defined in both the 2014 and 2022-2023 guides, there is no consideration of synergistic or cumulative impacts within the design of compensation of biodiversity in either document. b) There is no consideration of broader effects on the environment in either the 2014 or 2022-2023 guides.

Key: Level of adoption of the principles in the 2014 guide and 2022-2023 guides: ●, fully covered; ◗, partially covered; ○, absent. Principle included in the BBOP principles. Principle not included in the BBOP principles.

Table 4.2 Performance of Chilean policy against international best practice principles for biodiversity offsets

Principle	Chilean guide (2014)	Chilean guides (2022-2023)	Assessment Criteria	Observations
15. Compliance with monitoring and enforcement	◗	●	a) Oversight and compliance b) Legal and institutional frameworks c) Enforceable and auditable	a) The 2014 guide provided a framework to demonstrate the success of the compensation measures through monitoring and reporting, but the 2022 guide states specific indicators for verifying no net loss: "it is necessary to include the monitoring of indicators to verify progress towards the desired outcomes, including verifiable milestones with supporting means to prove that they were achieved, at different timeframes" (SEA, 2022, p. 46). b) Legal and institutional frameworks of monitoring are indicated in Law Nº19,300 (1984) and Law Nº20,417 (2010) of the Environment. This means the assessment criterion is met irrespective of the content of the National Guides. c) Offsets in Chile are enforceable and auditable through the Superintendency of the Environment which executes, organizes, and coordinates the follow-up and monitoring, according to the Law Nº20,417. This means the assessment criterion is met irrespective of the content of the National Guides.

Key: Level of adoption of the principles in the 2014 guide and 2022-2023 guides: ●, fully covered; ◗, partially covered; ○, absent. Principle included in the BBOP principles. Principle not included in the BBOP principles.

Table 4.2 Performance of Chilean policy against international best practice principles for biodiversity offsets

Principle	Chilean guide (2014)	Chilean guides (2022-2023)	Assessment Criteria	Observations
16. Participatory and transparent approach	◗	●	a) Stakeholder engagement b) Effective participation c) Transparency and communication	a) Both the 2014 and 2022-2023 guides describe the stakeholder participation process (SEA, 2022, p. 37). b) In terms of effective participation, both the 2014 and 2022-2023 guides state that "it is important to identify people and organisations [interested in biodiversity protection or affected by project impacts or even compensation measures] and invite them to participate at an early stage of project development, especially at the design stage of the project and compensation measures, prior to the project's entry into the EIA System" (SEA, 2022, p. 37). c) The 2014 guide does not have specific requirements for transparency and communication. However, transparency is a guiding principle since Chile signed the Escazú Agreement, and therefore was incorporated into the 2022 guide through the Guide for Early Citizen Participation (2023b): "the Escazú Agreement highlights the issue of transparency as a guiding principle that relates to other rights. When citizens exercise their right to participation, they need the guarantee of access to environmental information, and with it the obligation to generate and deliver this information, recognising also that, given the resources available, relevant environmental information must be disclosed and disseminated" (SEA, 2023b, p. 21).
17. Support evidence-based approaches	●	●	a) Rely on robust environmental information b) Integrating science with traditional knowledge	a) Both the 2014 and 2022-2023 guides emphasise the use of available scientific knowledge in the design of offsets (SEA, 2022, p. 42). b) Both the 2014 and 2022-2023 guides acknowledge that "the respect for traditional knowledge requires that it be appreciated in an equitable and complementary manner to the scientific knowledge… fundamental to the sustainable use of biological diversity" (SEA, 2022, p. 39), therefore incorporating science and traditional knowledge into the planning and implementation of offsets.

Key: Level of adoption of the principles in the 2014 guide and 2022-2023 guides: ●, fully covered; ◗, partially covered; ○, absent. Principle included in the BBOP principles. Principle not included in the BBOP principles.

Table 4.2 Performance of Chilean policy against international best practice principles for biodiversity offsets

Principle	Chilean guide (2014)	Chilean guides (2022-2023)	Assessment Criteria	Observations
18. Equity and rights-based approach	◗	◗	a) Equitable design and implementation of offsets b) Prioritise indigenous rights and local communities c) Free, Prior, and Informed Consent (FPIC)	a) Equity is not explicitly articulated in either the 2014 or the 2022-2023 guides. b) Both the 2014 and 2022-2023 guides assert the importance of respecting, preserving, and safeguarding the knowledge, innovations, and practices of indigenous and local communities (SEA, 2022, p. 39). c) The right of indigenous peoples to prior consultation and the principle of FPIC are not mentioned in either the 2014 or 2022-2023 guides.

Key: Level of adoption of the principles in the 2014 guide and 2022-2023 guides: ●, fully covered; ◗, partially covered; ○, absent. Principle included in the BBOP principles. Principle not included in the BBOP principles.

4.5 Discussion

A literature review was conducted to identify and synthesise international best practice principles for biodiversity offsets. This resulted in 18 principles which form the basis for an up-to-date analytical framework for policymakers and practitioners involved in the implementation of biodiversity offsets to evaluate specific offsetting policies. Building the framework to synthesise best principles presented several challenges, since there is no universal agreement on what constitutes best practice principles for biodiversity offsetting. Defining universally accepted principles depends on diverse stakeholder priorities and perspectives, which include conservation goals, economic interests, and social equity considerations (Bull et al., 2013; Maron et al., 2016). Additionally, there is no consistency in the literature regarding the definition and application of key principles. For instance, the concept of NNL is interpreted differently across contexts, largely depending on the reference scenario against which NNL is measured (Grimm & Köppel, 2019; Maron et al., 2018). Similarly, the principle of additionality is often ambiguously defined in the literature, leading to varied implementation practices. In some cases, additionality is interpreted narrowly, focusing on direct ecological gains, while in others, it includes broader socioeconomic or policy outcomes (Gardner et al., 2013; Weissgerber et al., 2019). This lack of consistency complicates the establishment of standardised principles, highlighting the need for greater clarity, consensus, and standardisation in the literature. However, effort has been made in this chapter to address these issues, providing a comprehensive set of principles aimed at harmonising best practices in

biodiversity offsetting. The analytical framework developed for the international best practice principles is intended to be globally applicable, serving as a benchmark for evaluating and enhancing biodiversity offset practices across various jurisdictions. This global applicability ensures that the principles can be adapted to local contexts while maintaining a consistent standard of conservation practice. Thus, the analytical framework can not only contribute to improved biodiversity offsetting policies and practices but also facilitate standardization in assessing biodiversity conservation efforts.

Assessing the Chilean biodiversity offset policy against international best practice principles (objective 1) reveals considerable alignment suggesting that Chile benefits from a good offsets policy, despite some key gaps. Chilean biodiversity compensation policy improved significantly in the recent 2022-2023 update and is now very well aligned with the BBOP principles of 2012 (BBOP, 2012a) as intended. All BBOP principles are fully implemented in the 2022-2023 guides, with the exception of equity, which is only partially addressed. This limitation primarily arises from the absence of provisions for FPIC in the National Guides, despite the principle of FPIC being a fundamental right for indigenous peoples and a key aspect of equity. The literature highlights that FPIC remains a highly contested issue in Chile (e.g., Figueroa et al., 2024).

The 2022-2023 updates have therefore established a robust foundation for biodiversity compensation in Chile, demonstrating strong alignment with international best practices. Nevertheless, the analysis has highlighted areas for further refinement to ensure equitable and inclusive implementation. Additionally, Chilean policy adheres to the principle of NNL, which is central to BBOP's framework (BBOP, 2018a), but was replaced with BNG in the analytical framework presented in

Table ***4.1***. Although NNL provides a foundation for responsible development by balancing biodiversity losses with equivalent gains, advancing toward BNG represents a significant policy upgrade, as also acknowledged by BBOP (BBOP, 2018b), ensuring measurable improvements in biodiversity beyond balancing impacts.

While most best practice biodiversity principles are comprehensively addressed in the Chilean policy, certain principles such as BNG, offsets from earliest stages, feasibility of the measures, the precautionary approach principle, and equity and rights-based approach, remain insufficiently integrated. To fully align with global advances in biodiversity conservation (Bull & Brownlie, 2017; Maron et al., 2020; Simmonds et al., 2022), Chile's policy needs to transition towards BNG and fully incorporate these principles. Finally, one principle was completely absent from the national criteria, involving the consideration of cumulative, direct, and indirect impacts, which have not been included within the design of compensation of biodiversity in either the 2014 or the 2022-2023 guides. Although the assessment of cumulative impacts is in the environmental regulation (MMA, 2012), some further guidance is needed to improve conservation outcomes specifically in term of compensation of biodiversity.

Internationally, biodiversity offsetting is fundamentally grounded in the mitigation hierarchy (Brownlie & Treweek, 2018; de Witt et al., 2019; Souza et al., 2023). Chile's regulations, both in 2014 and the 2022-2023 updates, reflect this hierarchy, promoting a structured, sequential approach that underscores the importance of avoiding impacts as a primary step. Despite this, the current guide 2022 follows the 2014 version in illustrating the mitigation hierarchy as a three-step sequence (Figure 4.1), where mitigation measures (in green) include avoid and minimise, which has been mostly associated in practice with the minimisation of impacts rather than their avoidance (see Chapter 5). Improving opportunities for implementing avoidance measures in the early stages of projects can significantly reduce the need for offsetting later in the project lifecycle (Phalan et al., 2018), enhancing the likelihood of achieving biodiversity NNL.

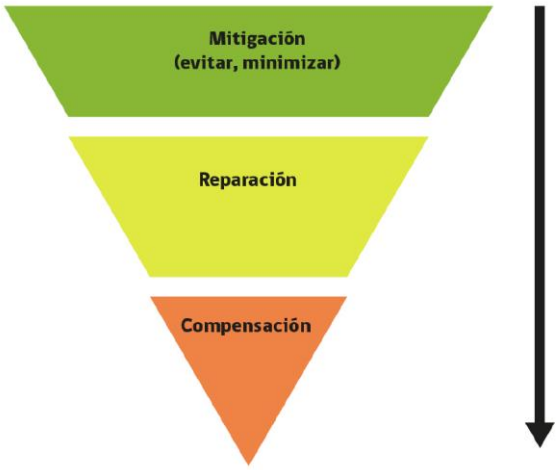

Figure 4.1 Hierarchy mitigation (hierarchy of measures in Chile) according to the 2022 guide (SEA 2022, p. 21)

Generally, Chile's updated biodiversity offsetting guidelines represent a significant step towards alignment with international best practice principles. The 2022-2023 National Guides strengthen adherence to the mitigation hierarchy through the methodology for quantifying residual impacts indicated in the methodological guide (SEA, 2023a), aspiring for NNL targets, incorporating limits to what can be offset, additionality and equivalence, requiring an assessment of the feasibility of the measures, emphasising long-term outcomes, ecosystem approach, compliance with monitoring, participatory processes, and supporting evidence-based approaches. However, areas such as fully operationalizing the precautionary principle, enhancing adaptive management protocols and embracing equity and rights-based approaches present ongoing challenges. Specific guidance for incorporating these principles would be a significant improvement over current policy.

The existence of a considerable gap between the worldwide implementation of biodiversity offsets and NNL and the supporting evidence for its ecological effectiveness has been described in the literature (Marshall et al., 2024; zu Ermgassen et al., 2019). While biodiversity offsetting has become a widely implemented strategy aimed at mitigating biodiversity loss, there remains a lack of robust, long-term studies demonstrating that these offsets consistently achieve their intended conservation outcomes (Bigard et al., 2017; Brownlie et al., 2013; Bull et al., 2017b). Addressing the gap between offsets policy and ecological outcomes thus requires reinforcing these principles with stronger evidence of more rigorous application. This research begins with an assessment of the Chilean biodiversity offsets policy against international best practice

principles (objective 1), as a foundational step to identify strengths and gaps in Chile's biodiversity offsets framework in relation to globally recognised standards, since integrating these principles more robustly into offsets design, monitoring, and enforcement could help to ensure that biodiversity offsets genuinely contribute to NNL in biodiversity, aligning policy with practical conservation success.

Chapter 5 Evaluating Chilean practice in relation to national obligations: quantitative analysis (objective 2) (also published as Cares et al. (2023))

5.1 Introduction

This chapter begins by exploring the practice of compensation of biodiversity (biodiversity offsets) in Chile, focusing on the design and application of the measures. The analysis centres on the adherence to the mitigation hierarchy, a key principle in offset implementation, which prioritises avoiding and minimising impacts before resorting to compensation. Furthermore, this study evaluates whether these measures have been successful in achieving their intended outcomes, analysing monitoring practices. By examining the effectiveness of the measures, this research aims to provide insights into their practical implementation and identify opportunities for improving the role of offsets in biodiversity conservation efforts in Chile.

While biodiversity offsetting principles provide a comprehensive framework for evaluating offsets in practice, this chapter does not analyse all principles detailed in Chapter 4. This limitation arises because Chapter 4 was not intended to frame the research study. Instead, the analysis of the compensation of biodiversity in practice took precedence, as understanding how biodiversity offsets are currently implemented was necessary to inform the development of the interview design. By first examining the practical application of compensation of biodiversity in Chile, this chapter was able to identify relevant themes and gaps, ensuring that the interviews were both targeted and effective in addressing key issues.

This chapter focuses on the practical application of the mitigation hierarchy to assess the extent to which biodiversity is being protected in practice. Specifically, it examines whether the mitigation hierarchy is being consistently followed and whether the monitoring of implemented measures is effective. By addressing these questions, this chapter provides a comprehensive understanding of how Chilean environmental legislation translates into on-the-ground conservation outcomes. This evaluation forms a critical link between policy and practice, highlighting successes, challenges, and areas for improvement in the implementation of biodiversity offsetting.

5.2 Is the mitigation hierarchy being followed?

For the 31 EISs analysed in this study, a total of 215 measures were proposed at the various levels of the mitigation hierarchy, as they are categorised in the EIS in Chile (see Table 2.2):

mitigation (140), repair (11), and compensation (64). The number of measures proposed for the projects in each sector is presented in Table 5.1. When the number of measures are compared to the model of mitigation hierarchy proposed by the National Guides (SEA, 2022), which is a simplification of that presented in Figure 2.1 including mitigation, repair and compensation (Figure 4.1), it is found that most of the identified measures are aimed at mitigating impacts, followed by measures aimed at compensating for impacts. This contradicts expectations according to the mitigation hierarchy, as the analysis of the 31 EISs in this study has revealed a tendency to use more compensation than repair measures (Table 5.1).

Table 5.1 Number of measures proposed by sector

Measure/Sector	Energy	Mining	Hydraulic	Sanitation	Housing	Others	Total
Mitigation	82	23	11	8	4	12	140
Repair	7	1	0	3	0	0	11
Compensation	37	20	4	1	0	2	64
Total	126	44	15	12	4	14	215

Analysing the distribution of the measures in the mitigation hierarchy by project, considering the 31 EISs reviewed, it was observed that 12 projects proposed all stages of the hierarchy: mitigation, repair, and compensation measures (when it was necessary). The majority of the projects (17) however, did not propose any repair measures, whilst a few projects (2) only proposed compensation for all the impacts, confirming the tendency to propose fewer repair measures than expected based on the National Guides.

The specific activities proposed as mitigation, repair, and compensation measures were extracted from the EISs, and categorised by type of activity as shown in Figure 5.1(a). Out of 19 categories established, seven had multiple classifications across the EISs. For example, rescue and relocation of fauna was considered to be mitigation in some EISs but also to be compensation in others; and rescue and relocation of plants was categorised differently as mitigation, repair, and compensation. Therefore, the activities described in the EISs were examined in depth, reviewing the content of each planned measure, to determine whether these inconsistencies corresponded to a contextual situation or if some misclassification could be detected.

The multiple classifications (e.g., habitat restoration) disappear after the reclassification (Figure 5.1(b)). Activities related to environmental training, studies, and economic financing were classified as accompanying measures rather than levels of mitigation measure (see next

paragraph). Overall, it was found that 178 out of 215 measures correctly followed the mitigation hierarchy classification indicated in the National Guides for each category (SEA, 2014, 2022) representing 83% of the total proposed measures. Thus, 37 measures were initially misclassified (17%) (Figure 5.2).

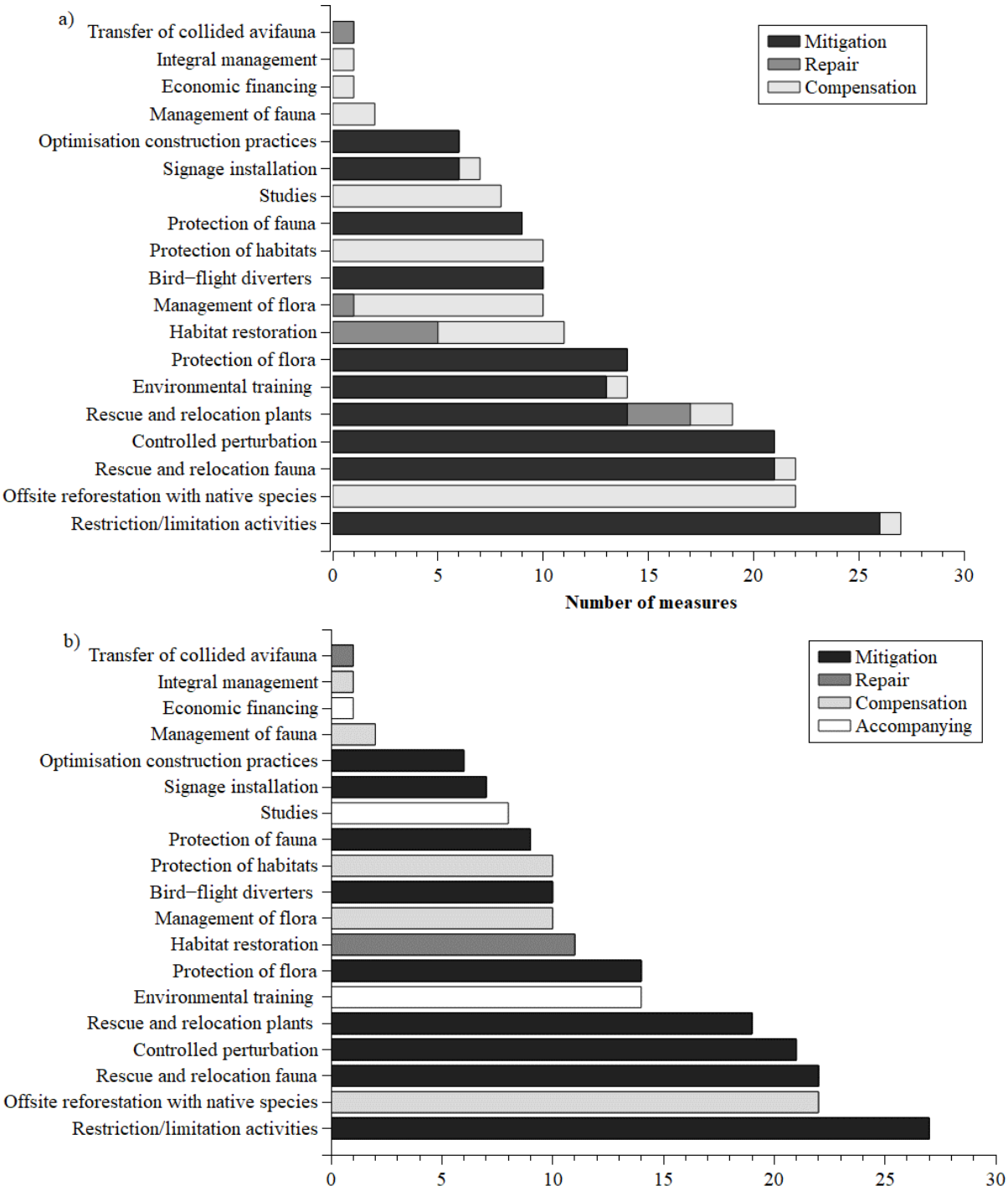

Figure 5.1 Number of specific types of mitigation, repair, and compensation measures reported in the 31 EISs selected (a) and once they were reclassified (b)

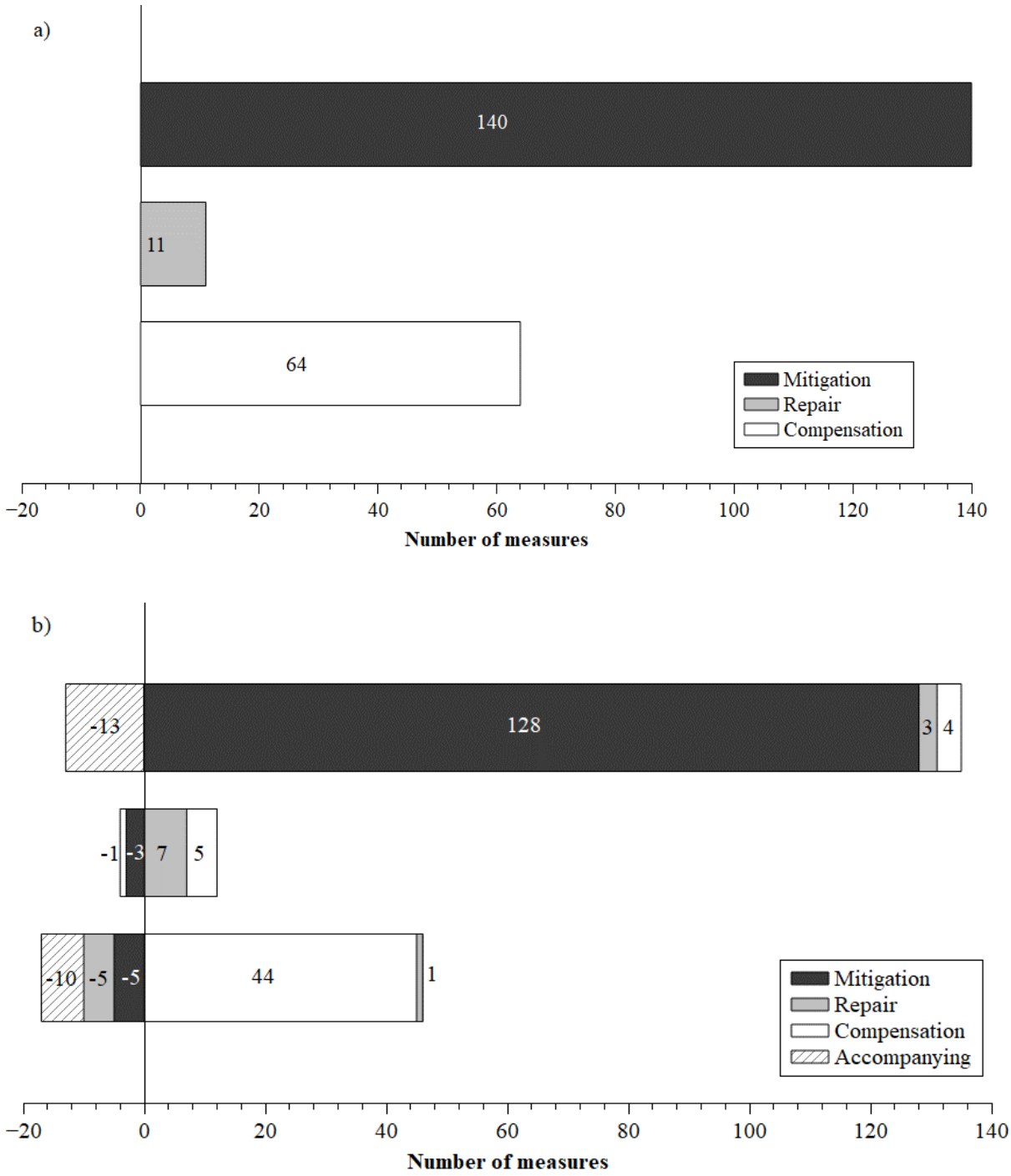

Figure 5.2 Total of proposed measures (215 in the 31 EISs) for each category (a) and once they were re-evaluated following the 2014 guide (b)

In the re-evaluation of the measures, those that "*improve the effectiveness of offset measures or to additionally safeguard their environmental success*" (Jacob et al., 2016, p. 84), such as knowledge acquisition, socio-economic activities, awareness-raising measures, among others (Jacob et al., 2016) were classified as accompanying measures in this study as they have no tangible or measurable biodiversity outcome. They represented 11% of the total number of measures proposed. They also included measures related to "staff environmental training" and

"workers training talks", for which CONAF indicates that "*training talks for staff on flora and vegetation will not be considered as a mitigation measure*" (CONAF, 2020, p. 40).

The reclassification also allowed mitigation measures to be separated into avoidance and minimisation by the researcher, which are otherwise combined in the category of 'mitigation' within the EIS (according to the 2014 guide). This allows a clearer examination of the use of the mitigation hierarchy. In this regard, most of the re-classified measures proposed for mitigation were minimisation (121 being 56% of the total of 215 measures) rather than avoidance (14 measures corresponding to 7% of the total of 215 measures) (Figure 5.3). Bigard et al. (2017) found that reduction or minimisation of impacts is by far the most common measure proposed in practice for biodiversity, which is consistent with the results of this study, where most of the measures proposed within the EISs corresponded to restriction or limitation of activities, rescue and relocation of species and controlled perturbation, which would often be aimed at minimising impacts, especially in the construction phase. Avoiding impacts on biodiversity is rarely proposed as the first alternative in the mitigation hierarchy (Bigard et al., 2017; Larsen et al., 2018; Phalan et al., 2018). In this study, the 14 avoidance measures were proposed by energy, hydraulic, and 'others' projects, whereas for mining projects, avoidance measures such as reducing the affected area or changing the location area do not seem viable alternatives due to the nature of the project. Although more emphasis is placed in the literature on the avoidance stage of the mitigation hierarchy (Ekstrom et al., 2015; Maron et al., 2016; Phalan et al., 2018), the context for the project in terms of location, sector, and the nature of the impact, all seem to influence the extent to which this is realistic.

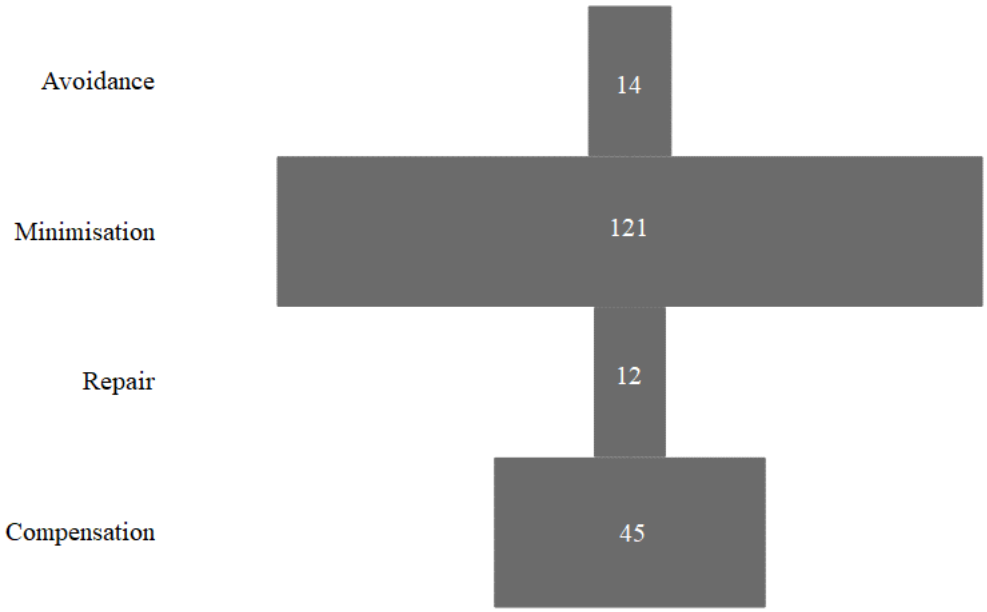

Figure 5.3 Representation of the mitigation hierarchy found in this study

The same arguments apply to repair measures; as shown in Figure 5.3, repair measures were the least proposed, even though the National Guides prioritise repair over compensation (SEA, 2022). Repair measures are designed to replace or restore the basic properties of one or more components to a quality similar to that which they had before the impact (MMA, 2012; SEA, 2022), implying that the repair must be done in the place where the impacts occur. However, in practice, it is not always possible to repair the impacts due to the biodiversity loss that occurs through replacement with infrastructure, which leads inevitably to compensation (offsetting) as the next viable step. In this study, none of the mining projects proposed avoid or repair measures, mostly because it is difficult to recover biodiversity in the place where it has been affected, due to the construction and operation of the project.

Finally, 45 measures were in fact compensation measures, most of them being reforestation, management of flora and protection of habitats. By examining the sequence of the mitigation hierarchy, it was found that compensation measures (compared to the number of repair measures proposed) are included more often than expected, especially considering that they should be used as a last resort (SEA, 2022). However, as discussed earlier, repair measures are not always a viable alternative to be considered before compensation, based on the nature of the projects. Usually, compensation measures are proposed in specific locations where nature has been replaced by infrastructure, especially in mining or energy projects in Chile. In these cases, the choice of compensation measures is likely a standard response where it is not possible to mitigate or repair. Further investigation would be needed to understand why compensation

seems to be the preferred course of action rather that repair, considering the nature of the project, and operational and financial costs.

5.3 Is the monitoring of the measures implemented effective?

One monitoring report is required to be submitted to the Superintendency of the Environment for each measure established in the planning permission. Given that 215 measures were evaluated in this research, it was expected that 215 corresponding monitoring reports would be available in the online database. Overall, out of 215 monitoring reports required from the total of 31 projects, 100 reports were available for examination (47%).

Table ***5.2*** shows the level of completion or progress (where progress is the number completed divided by the number required) for each project; on average the level of progress is 34% across the 31 projects that have monitoring data. The number of 'completed' reports corresponds to monitoring that has taken place and has already finished (it should be noted that that the scope and duration of monitoring programmes influence the level of completion of each report), while 'available' includes those which are completed, and those taking place over a longer term where the monitoring is still ongoing and therefore the data are only partially collected (the amount of time that the monitoring lasts has not finished yet). The information obtained from the public online database of the Superintendency of the Environment does not give the reasons why there are some reports missing (the difference between the number of reports required, and the number available).

Table 5.2 Number of monitoring reports required, available and completed by project to date (as of March 9, 2022)

Project	Approval Year	Required n = 215	Available n = 100	Completed n = 73	Progress %*
Proyecto Nueva Línea 2x500 kv Charrúa-Ancoa: tendido del primer conductor	2015	13	11	8	62
Línea 2x220 kV Ciruelos-Pichirropulli	2015	17	6	6	35
Explotación Minera Oso Negro	2015	10	4	4	40
Proyecto Parque Solar Quilapilún	2015	4	4	2	50
Proyecto Santo Domingo	2015	7	3	3	43
Candelaria 2030 - Continuidad Operacional	2015	7	2	2	29
Proyecto Parque Eólico Aurora	2015	5	1	0	0
Plan de Expansión Chile LT 2x500 kV Cardones – Polpaico	2015	12	8	8	67
Proyecto El Espino	2016	5	3	0	0
Mini Central Hidroeléctrica de Pasada Cipresillos	2016	4	2	0	0
Nueva Línea 2x220 kV Encuentro-Lagunas	2016	8	4	4	50
Ampliación y Modernización Planta Enaex S.A. La Serena	2016	9	2	2	22
Parque Fotovoltaico Santiago Solar	2016	3	3	2	67
Planta Desalinizadora de Agua de Mar para la Región de Atacama, Provincias de Copiapó y Chañaral	2016	12	2	2	17
Parque Eólico Malleco	2016	3	1	1	33
Embalse de Regadío Las Palmas	2016	9	2	2	22
Proyecto Hidroeléctrico Embalse Digua	2017	4	2	2	50
Minicentrales Hidroeléctricas de pasada Aillín y Las Juntas	2017	16	6	3	19
Minerales primarios Minera Spence	2017	1	1	1	100
Infraestructura Complementaria	2018	7	4	2	29
Proyecto mejoramiento de la generación, transporte y disposición de residuos arsenicales de división el teniente	2018	3	1	1	33
Planta Fotovoltaica Santa Rosa	2018	3	2	0	0
Parque Eólico Cabo Leones III	2018	3	3	2	67
Concesión Vial Puente Industrial	2018	6	3	3	50
Mirador de Lo Campino	2018	4	2	0	0
Línea de Transmisión Lo Aguirre - Alto Melipilla y Alto Melipilla – Rapel	2018	16	6	4	25
Nuevas Líneas 2x220 kV entre Parinacota y Cóndores	2019	3	2	2	67
Estudio de Impacto Ambiental Proyecto Salares Norte	2019	4	3	1	25
Estudio Impacto Ambiental Circunvalación Oriente Calama	2020	5	2	2	40
Nueva Línea Nueva Maitencillo -Punta Colorada - Nueva Pan de Azúcar 2x220 kV, 2x500 MVA	2020	8	4	3	38
Nueva Línea Transmisión 2x220 kV Nueva Pan de Azúcar-Punta Sierra-Centella	2021	4	1	1	25

*Note: % progress is calculated based on the proportion of required reports which are completed

The type of monitoring and the indicator that is being monitored was extracted from each monitoring report. Overall, out of 100 reports, 69 aimed to monitor some biodiversity-related indicator, delivering biodiversity outcomes. Whilst 31 reports included other types of indicators derived from visual inspections and studies, which were considered to be implementation indicators (

Table ***5.3***).

Table 5.3 Types of monitoring that projects have implemented and the indicator that is being monitored

	Type of monitoring	Indicators	Number of reports
Biodiversity-related indicator	Systematic fauna surveys	Richness and abundance	18
		Presence of individuals	6
		Number of individuals	2
	Wildlife observations	Presence of individuals	9
		Number of individuals	1
	Systematic flora surveys	Survival of individuals	18
		Number of individuals	5
		Richness and abundance	2
		Plant cover	2
		Number of seeds	1
		Germination and flowering	1
		Plant density	1
		Presence of individuals	1
	Systematic flora and fauna surveys	Richness and abundance	1
	Measure of habitat	Area	1
Implementation indicator	Visual inspection	Activity recorded	19
		Installation of equipment	8
		Attendance record	2
	Studies	Report delivered	2
Total			100

Almost one third of the reports (31%) assessed the success of the measures based on the implementation of the measures (qualitative outcomes), e.g., if the measure was carried out according to what was indicated in the monitoring planning in the EIS (methods, place, timing). Most of them relied on visual inspection-based monitoring (29%) where the activity is recorded through photographs or checklists (being the most common indicators of success of the measures), followed by the verification of the installation of devices such as bird-flight diverters or signage. However, these monitoring reports do not provide quantitative information for biodiversity outcomes as the results are based mainly in the implementation of

the measure (on the assumption it will work as intended), rather that the effectiveness of the measure in terms of measured biodiversity outcomes.

Activities such as attendance records for worker environmental training, as well as the delivery of scientific studies carried out to generate knowledge about the component of biodiversity affected, were classified as accompanying measures in this study. Therefore, they are not expected to quantify biodiversity outcomes. They accounted for 4% of all the monitoring reports reviewed in this study.

In terms of biodiversity outcomes, 69% of the monitoring reports used a biodiversity-related indicator (quantitative outcomes). However, the outcomes on biodiversity were based on proxies for biodiversity (e.g., the most common indicators were richness and abundance for fauna (18%) and survival of individuals for flora (18%)), rather than on detailed quantification of biodiversity losses or gains. The biodiversity-related indicators tend to be species-specific as the monitoring is focused mainly on fauna and flora species, rather than habitats or ecosystems (Gardner et al., 2013; Quétier & Lavorel, 2011). This approach limits the ability to adopt an ecosystem-based approach, which is one of the best practice principles for biodiversity offsets highlighted in Chapter 4 (see Section 4.2.12). For example, the monitoring reports provided data on the number of native trees planted, or the number of flora/fauna species rescued and relocated, but none reported data on the dynamics of new animal/plant communities or ecosystems created that would indicate the impacts were successfully mitigated, repaired, or compensated as a result of the implementation of the measures. There was only one monitoring report (one out of 31 projects) that quantified the residual impacts on biodiversity throughout the process that would allow a justification of a decision on whether compensation was required.

Twenty-nine out of 31 projects reported biodiversity outcomes at some level, as they proposed at least one biodiversity-related indicator (

Table ***5.4***). Seventeen of these were entirely focused on biodiversity-related indicators, delivering the results in terms of biodiversity outcomes, even when they did not quantify biodiversity, as discussed above.

Table 5.4 Number of measures implemented (report available to March 9, 2022), and the number of implementation/biodiversity-related indicators proposed for each measure

Project	Measures implemented	Implementation indicator		Biodiversity-related indicator	
	n = 100	n = 31	%	n = 69	%
Proyecto Nueva Línea 2x500 kv Charrúa-Ancoa: tendido del primer conductor	11	3	27	8	73
Línea 2x220 kV Ciruelos-Pichirropulli	6	4	67	2	33
Explotación Minera Oso Negro	4	-	-	4	100
Proyecto Parque Solar Quilapilún	4	3	75	1	25
Proyecto Santo Domingo	3	1	33	2	67
Candelaria 2030 - Continuidad Operacional	2	-	-	2	100
Proyecto Parque Eólico Aurora	1	-	-	1	100
Plan de Expansión Chile LT 2x500 kV Cardones – Polpaico	8	2	25	6	75
Proyecto El Espino	3	-	-	3	100
Mini Central Hidroeléctrica de Pasada Cipresillos	2	1	50	1	50
Nueva Línea 2x220 kV Encuentro-Lagunas	4	2	50	2	50
Ampliación y Modernización Planta Enaex S.A. La Serena	2	-	-	2	100
Parque Fotovoltaico Santiago Solar	3	-	-	3	100
Planta Desalinizadora de Agua de Mar para la Región de Atacama, Provincias de Copiapó y Chañaral	2	-	-	2	100
Parque Eólico Malleco	1	-	-	1	100
Embalse de Regadío Las Palmas	2	-	-	2	100
Proyecto Hidroeléctrico Embalse Digua	2	2	100	-	-
Minicentrales Hidroeléctricas de pasada Aillín y Las Juntas	6	4	67	2	33
Minerales primarios Minera Spence	1	-	-	1	100
Infraestructura Complementaria	4	1	25	3	75
Proyecto mejoramiento de la generación, transporte y disposición de residuos arsenicales de división el teniente	1	-	-	1	100
Planta Fotovoltaica Santa Rosa	2	-	-	2	100
Parque Eólico Cabo Leones III	3	1	33	2	67
Concesión Vial Puente Industrial	3	-	-	3	100
Mirador de Lo Campino	2	-	-	2	100
Línea de Transmisión Lo Aguirre - Alto Melipilla y Alto Melipilla – Rapel	6	5	83	1	17
Nuevas Líneas 2x220 kV entre Parinacota y Cóndores	2	-	-	2	100
Estudio de Impacto Ambiental Proyecto Salares Norte	3	-	-	3	100
Estudio Impacto Ambiental Circunvalación Oriente Calama	2	-	-	2	100
Nueva Línea Nueva Maitencillo -Punta Colorada -Nueva Pan de Azúcar 2x220 kV, 2x500 MVA	4	1	25	3	75
Nueva Línea Transmisión 2x220 kV Nueva Pan de Azúcar-Punta Sierra-Centella	1	1	100	-	-

Although the mitigation hierarchy effectiveness depends on the full implementation of the measures (Drayson & Thompson, 2013; Morrison-Saunders et al., 2021; Sánchez & Gallardo, 2005), it is not possible to assess the effectiveness of the measures implemented without monitoring information about the biodiversity outcomes targeted by the intervention (Panfil & Harvey, 2016). Measurable and quantitative targets should be stipulated in the monitoring plan in the EIS, as it is established by the law (MMA, 2012). However, it was found that 31% of the monitoring data are reporting qualitative outcomes. Measurable and quantitative targeted monitoring is essential for verifying the effectiveness of the mitigation measures (Drayson & Thompson, 2013; Morrison-Saunders et al., 2021; Sánchez & Gallardo, 2005). This research suggests monitoring can be improved and give greater focus to the quantification of the biodiversity outcomes resulting from the mitigation measures.

5.4 Discussion

This study evaluated the extent to which biodiversity is being protected from impacts of development projects by the Chilean environmental legislation implemented in 2014. The country's policy framework includes legislation to deliver the mitigation hierarchy within its EIA System. However, in practice the implementation of the mitigation hierarchy and the monitoring of quantifiable biodiversity outcomes remains challenging.

This review of all information available up to 2022 showed projects have a tendency to use more compensation measures than would be expected from the implementation of the mitigation hierarchy. There is limited use of repair measures, and avoidance measures were rarely proposed. This bias towards compensation may indicate a poor use of the mitigation hierarchy (Glasson & Therivel, 2019). However, in some contexts, for example mining projects, where the impacts on the area affected cannot be avoided and repaired, as the projects cannot be relocated or reduced in scale, compensation may be the only option available. Other project types, such as, energy, hydraulic, sanitation, housing, and others, could potentially make a greater effort to include measures that avoid impacts on biodiversity.

Thus, the inverted mitigation hierarchy pyramid expected based on theory and guidance, is not relevant to all project types. Further research is needed to determine the underlying causes for the preponderance of compensation measures in the majority of the projects in this study, to determine whether this is due to financial and logistical expedience. At the time of writing,

there was no mandated limit on how much to compensate, and for most projects compensation seemed to be the preferred option (where repair was not feasible), therefore some of these factors might be influencing the decision on the level of compensation.

This study has also shown that misclassification of the measures throughout the mitigation hierarchy whilst present, is not a major issue in relation to biodiversity outcomes. Nevertheless, practice can be improved to ensure that misclassification does not subvert the correct use of the mitigation hierarchy. Furthermore, the classification of accompanying measures that are not actual mitigation measures represents a waste of monitoring effort. By refining the classification process, efficiency savings could be achieved in the monitoring system, allowing resources to be better focused on actual mitigation measures that directly contribute to biodiversity outcomes.

Regarding EIA-related biodiversity monitoring, this study identifies some missing reports that either have not taken place yet or have not been submitted to the public database. A subsequent long-term assessment would be required to understand whether this was evidence of omission, or simply a facet of timing. Nevertheless, some measures were being claimed as successful based purely on implementation (the verification of the activity being conducted), rather than on evaluation of biodiversity outcomes.

Despite many projects delivering biodiversity-related indicators, there was rarely an attempt to quantify biodiversity outcomes through all the levels of the mitigation hierarchy that would allow the measurement of NNL (Drayson & Thompson, 2013; Ekstrom et al., 2015; Gelot & Bigard, 2021). Additionally, the focus was on selected elements of biodiversity which paint a partial picture of the outcomes, without considering the wider consequences for ecosystems (Gelot & Bigard, 2021; Boileau et al., 2022). Even though it depends on the component of biodiversity whether it can be mitigated, repaired, or compensated, the measures should aim to conserve unique ecosystems or threatened species that depend on specific conditions in their environment. The introduction into the national legislation of the 'Methodological guide for the compensation of biodiversity in continental terrestrial and aquatic ecosystems' (SEA, 2023a), may lead to some improvements in quantification of all the components of biodiversity, allowing the achievement of biodiversity NNL.

In conclusion, the main findings of this chapter highlight four key areas of the implementation of biodiversity offsetting in Chile:

1. Inappropriate use of the 2014 guide (as of the date of this chapter) which plays a critical role in guiding the design and execution of offset measures.
2. Adherence to the mitigation hierarchy has not been largely followed, failing to ensure that avoidance, minimisation and repair strategies are prioritised over compensation.
3. Further improvements in practice are needed to ensure that biodiversity outcomes are consistently achieved, in terms of NNL.
4. The effectiveness of monitoring remains a key factor in ensuring the success of biodiversity mitigation measures, with room for refinement in reporting and tracking to enhance efficiency and accuracy.

These findings offer valuable insights into both the strengths and areas for improvement in the current approach to biodiversity offsetting in Chile.

Chapter 6 Evaluating Chilean practice in relation to national obligations: qualitative analysis (objective 2)

6.1 Introduction

This chapter presents the qualitative findings related to the second objective of the thesis 'to evaluate Chilean practice in relation to national obligations', which seeks to explore the research question 'How can the EIA System in Chile help achieve no net loss of biodiversity?'. Semi-structured interviews were conducted to capture in-depth insights from participants, to gain an understanding of whether the EIA System is delivering NNL through the fulfilment of the national obligations. The data collected through these interviews were analysed using an exploratory and inductive approach to coding and thematic analysis (Braun & Clarke, 2012; Creswell & Creswell, 2017).

The following Sections are organised around the key findings identified during the quantitative analysis presented in Chapter 5 (Section 5.4), facilitating a clear and coherent exploration of these findings:

1. Use of the 2014 guide and the National Guides (2022-2023);
2. Adherence to the mitigation hierarchy;
3. Achieving biodiversity NNL; and
4. Effectiveness of the monitoring.

These themes provide a comprehensive answer to the research questions and offer new insights into the Chilean practice related to biodiversity offsetting in relation to national obligations. Each theme is presented with supporting quotes from the interviews to illustrate the viewpoints of the participants (Table 6.1). The quotes were translated into English by the student and the original text in Spanish can be found in Appendix 8.

Interviews were conducted with 12 stakeholders including developers (3), consultants (3), evaluators from the Environmental Assessment Service (2), reviewers of the Environmental Impact Study (2), and monitoring officers from the Superintendence of the Environment (2). Data saturation was largely achieved with ten interviews, resulting in 93% of the codes being developed (41 out of 44). Therefore, despite the small sample size, the data appeared to be relatively stable by the tenth interview, giving confidence that the thematic analysis is robust.

Table 6.1 Results of the thematic analysis

Themes	Codes	Participants (n=12)	Number of references
1. Use of the 2014 guide and the National Guides (2022-2023)			
Authorities not using the guides effectively		**9**	**38**
	Authorities not following the Guide through ignorance or belligerence	8	22
	Evaluator lacking expertise	6	16
Challenges in the effective use of the guides		**9**	**21**
	Difficult to meet the Guide criteria	3	3
	Effective use of the Guide depends on the context of the projects	4	5
	Lack of use of the Guide by developers and consultants	6	7
	Misunderstanding of the concepts of the Guide	4	6
Flaws in the first Guide (2014)		**3**	**6**
	Very broad guidelines	3	3
	Does not provide a methodology	1	3
Improvements in the updated Guide (2022-2023)		**5**	**11**
	Updated Guide (2022-2023) defines compensation area	1	2
	Updated guide (2022-2023) provides a methodology and concept of landscape	5	8
	Updated Guide (2022-2023) reduces uncertainty	1	1
2. Adherence to the mitigation hierarchy			
Constraints influencing the implementation of measures		**6**	**19**
	Area of influence does not allow the implementation of repairs	3	5
	External factors prevent the implementation of measures	3	4
	Operating condition determines the practicability of the measures	4	8
	Poor implementation of the measure	1	2
Factors influencing the choice of measures (design)		**7**	**35**
	Habitat loss cannot be mitigated or repaired	2	3
	Impacts that cannot be compensated	1	1
	Incomplete design favours compensation measures	3	6
	Measures based on costs	4	9
	Measures based on previous experiences not knowing whether they are working	5	16
Mitigation hierarchy is not followed		**4**	**6**
	Lack of justification of mitigation hierarchy level	2	2
	Misclassification of measures	3	4

Table 6.1 Results of the thematic analysis

Themes	Codes	Participants (n=12)	Number of references
3. Achieving biodiversity NNL			
Lack of scientific knowledge		**4**	**6**
	Lack of basic knowledge on biodiversity ecology	4	6
Failure to quantify biodiversity loss		**8**	**28**
	Difficult to quantify biodiversity loss	2	2
	NNL could not be verified	6	13
	Quantification of impacts based on proxies for biodiversity	5	13
Inadequate environmental impact assessment		**3**	**4**
	Baselines are not adequate to quantify impacts	2	3
	Lack of studies on cumulative impacts	1	1
The measures are not aimed at achieving NNL		**6**	**22**
	Difficult to compensate high biodiversity values areas	1	2
	Lack of compensation measures based on restoration	2	2
	Measures targeting species in conservation status	2	6
	Measures with low probability of success	5	12
4. Effectiveness of the monitoring			
Inadequate monitoring practices		**5**	**11**
	Implementation of the measure is reported, not the biodiversity outcome	3	3
	Lack of monitoring data to verify NNL	4	7
	Low level of standardisation of measures complicates effective monitoring efforts	1	1
Lack of staff capacity for fulfilling monitoring tasks		**5**	**10**
	Authority reviewers are not involved in the monitoring	3	4
	Insufficient number of monitoring officers	3	3
	Lack of feedback between relevant authorities	2	3
Need for more comprehensive monitoring strategies and quantitative indicators		**10**	**17**
	Difficulty monitoring microfauna	2	4
	Lack of quantitative success indicators	6	9
	Monitoring focuses on limited range of biodiversity elements	3	3
	Monitoring is too short term	1	1

6.2 Use of the 2014 guide and the National Guides (2022-2023)

The Chilean policy for biodiversity offsetting was initially published in 2014 (2014 guide) (SEA, 2014). However, this guide was superseded by an updated guide in 2022 (SEA, 2022), alongside the methodological guide (SEA, 2023a) and the citizen participation guide (SEA, 2023b). The 2014 guide and the 2022-2023 guides are binding to the EIAS and stipulate the design of the compensation of biodiversity. Therefore, the interview questions investigated if these guides were properly being used during the environmental impact assessment process by both the developer of the projects (including their consultants) and the relevant authority.

6.2.1 Authorities not using the guides effectively

Relevant authorities, either evaluators or reviewers need to consult and follow the content of the 2014 guide and National Guides during the environmental impact assessment process. In this regard, many of the interviewees expressed their concern regarding authorities not following the 2014 guide and the National Guides. Consultant C1 considered that *'the initiative to publish guides on biodiversity is very interesting, but I think that, in relation to the issue of implementation that we just discussed, I think that the authority often publishes guides and does not have 100% clarity on how these guides are going to be put into practice'*. Regarding the requirements in the National Guides, consultant C2 said that *'it will depend on the arbitrary judgement of the evaluator'*, and consultant C3 expressed that *'sometimes it happens ... measures indicated are so big, are so important in terms of extension and work, that finally the services* (the reviewers) *end up negotiating in some way, and the guide, the conceptual issues of the guide move to a second plane, third plane'*. Concerning the perspective of the reviewers, evaluator E1 admitted that *'it happens a lot that some services* (reviewers) *raise issues that have nothing to do with environmental assessment ... we do not consider these observations. And we only leave here observations that are purely strictly environmental'*. Also, evaluator E2 agrees that *'many cases ... of inter-sectoral lack of coordination, where they* [reviewers] *pronounce more than they should, or demand more than they should, going a little bit beyond their competences'*.

Another aspect emerging from this research was the lack of expertise of the evaluators. Consultant C2 questioned the capacity of evaluators to assess complex projects in term of analysis of biodiversity: *'Really, how can we expect to have a good assessment, applicability of the guide ... if the evaluator ... has no experience in modelling, I don't know, in any specific*

study that the consultancy firms are presenting and affirm that it complies or not with the guide'. Consultant C3 also agrees saying *'I don't know if there is an understanding* [by the evaluators] *of the guides that are being proposed … and of the general guides that are being established, I would say that there is not'*. In this regard, evaluator E2 adds *'now clearly there are many regions in the country, the evaluators have more or less experience, there are new people... So, if you ask me, are they familiar?* [with the national guides] *I would say they must be familiar, now the fact that some do it better than others, that's part of life, let's say, it's part of the learning process because the documents always have to be incorporated'*.

6.2.2 Challenges in the effective use of the guides

The interviewees determined some challenges in the effective application of the national guides in practice. A few of them stated that it was difficult to meet the criteria of the national guides. Consultant C2 said that '*it is impossible … because there are a series of formulas and criteria that are impossible to achieve, I mean, I don't know, at that time I remember that we also made a review of other studies that could have effectively applied biodiversity compensation measures, as indicated in the guide, and I assure you, at least from what I could see, none in clear and quantifiable terms, could have done so'*. Developer D3 added that '*it is difficult to manage because the specialist has to justify it very well in the reports … I believe to really achieve what is asked in these guides, in parameters that can be demonstrably achieved, I believe that it is a difficult task to achieve'*. Also, reviewer R2 stated that *'the issue about the metrics* [in the guide] *is the most complicated'*.

Another challenge identified was that the effective use of the national guides depends on the context of the projects. When the interviewees were asked whether they implement the requirements of the national guides, consultant C3 said that *'we are still at a stage where we are seeing if it is possible or not to apply it* [the national guides]*, in general in some projects I see that it is very difficult, in others it is not, in others it is possible. But it depends on the magnitude of the project and the magnitude of the elements to be compensated, though'*. Developer D2 expressed that *'the truth is that* [the proposed measures] *corresponds to the nature of the project'*, and developer D3 argued that *'I believe that implementing it* [the National Guides] *does work, but you find yourself confronted with external factors that are often difficult to manage and are out of your hands'*.

Moreover, a lack of use of the Guide by developers and consultants was recognised for many of the interviewees. Consultant C2 stated: *'I believe that in this project and in others it* [the national guides] *is not used clearly and effectively* [guide]*'*. Consultant C3 thinks that *'few projects have yet considered the guide* [in the assessment process]*'*. Concerning projects not necessarily following the requirements of the national guides during the assessment process, developer D3 affirmed that *'you might come across compensation a lot, because it is generally accepted by the* [EIA] *system. It is accepted by the assessment, and it is a more manageable resource for the developer'*. Regarding the correct use of the National Guides, evaluator E1 acknowledges that *'it can happen that the developer uses the methodology but uses it erroneously or does not present all the background information to be able to justify each value of the parameters established by the methodology'*. Additionally, when reviewer R1 was asked about the use of the national guides, admits that *'sometimes not, indeed, the developer does not present them* [the requirements of the guide] *in such a way. And indeed, this is where one has to make the corresponding observations as a service* [reviewer] *in order to ensure that they are fulfilled'*.

Finally, a misunderstanding in the concepts of the national guides was also identified as a key issue. Reviewer R2 claims that *'it did give room for interpretation and in the end, the numbers* [quantifying biodiversity] *were unmanageable'* and added that it *'is not a problem of the method* [in the National Guides]*, it is a problem of the interpretation given to it'*. Consultant C3 explains that the requirements of the guide are not always met due to nuances in the concepts: '*One of the criteria to be able to compensate is that you need an area that is outside the area of influence, that has different characteristics from the area of influence. And this was an area that was almost overlapping the area of influence … So, there's a kind of a crossover that in this case when you put the guide and when you carry it out, when you check it, you don't meet it'*, and evaluator E2 stated that *'basically the 2014 guide has principles but then these principles were interpreted or put into practice in different ways because there was no way that the service was indicating how to do it'*.

6.2.3 Flaws in the first Guide (2014)

As the national guide of 2014 was updated in 2022 whilst this research was ongoing, some interviewees talked about limitations of the former guide. A few of them referred to the fact that the 2014 guide provided very broad guidelines, as Consultant C1 expressed *'it showed very general guidelines with regard to biodiversity'*. Evaluator E1 mentioned that *'that guide was*

rather theoretical', and reviewer R2 commented that *'it's just that the 2014 one was very bad. It was very bad because it was a copy of the BBOP without taking out all the criteria that the BBOP had'*. Moreover, Consultant C1 referred to that guide as it does not provide a methodology to quantify biodiversity: *'the truth is that the guide at that time only gave you a very general formula'* and added that *'*[the guide] *has a very general formula which relates the quality of the site by area to calculate certain things. But it doesn't give a methodology for that'*.

6.2.4 Improvements in the updated Guide (2022-2023)

Interviewees identified the improvements in the updated 2022-2023 guides, starting with the delivery of a methodology and the incorporation of a landscape and ecosystem approach, which would represent progress in the quantification of biodiversity. Consultant C1 indicated that *'it is a much more formal guide with quantitative methodologies mainly for estimating residual impacts and gains'*. Consultant C3 also agrees: *'Because now there are metrics, there are metrics that kind of guide you'*. Evaluator E1 indicates that *'by being able to quantify, to put a number, it is easier to verify whether a zero net loss or gain is actually being achieved, so with the methodological guide, it is possible ... not only in theory, but in a practical methodology, so that we can, on the one hand, demand that to the developers'*. Evaluator E2 adds *'in the past there was not a very comprehensive vision of an ecosystemic perspective, there was a more specific perspective of species, of certain species in a conservation category, so when we talked about biodiversity in reality, there was not a complete meaning of what biodiversity implies at all levels of organisation, from the landscape, ecosystem, to population, genetic ... So that is the reason for this methodological guide, it gives a quantification, for the first time a way of quantifying'*.

Consultant C1 added the fact the guide of 2022 incorporates the concept of compensation area and biodiversity value: *'If your area of impact is very good* [in terms of quantity and quality of biodiversity]*, you will have to compensate more. On the other hand, if your area of compensation is also relatively good, you are going to have to compensate much more than what you impacted. So, that's the beauty of this new guide, which intrinsically brings in this concept of carrying capacity, that is, if your area is very good, you can't compensate 1:1'*.

Additionally, Consultant C1 also referred to the updated guide reducing uncertainty: *'The new guide forces the developers to take responsibility for the sustainability of the measure ... If the*

measure you originally put in place doesn't work, well, you'll have to find a way to make it work'.

6.3 Adherence to the mitigation hierarchy

The mitigation hierarchy is a framework that prioritises actions to avoid, minimise and restore negative impacts on biodiversity before considering compensatory measures (Glasson & Therivel, 2019). In Chile, the mitigation hierarchy is defined in the National Guides as the sequential application of measures to reduce the potential negative impacts of development projects on biodiversity: (i) mitigation (which includes avoidance and minimisation) ; (ii) repair (corresponding to rehabilitation/restoration); and (iii) compensation (referred to as offsets) (SEA, 2014, 2022). As the National Guides state that mitigation and repair should be prioritised over compensation, in order to prevent biodiversity loss, the interviewees were asked whether they followed the mitigation hierarchy (developers/consultants) or were aware that mitigation hierarchy was being followed (evaluators/reviewers/monitoring officers) in order to propose the measures (as it was shown in Chapter 5 that the mitigation hierarchy was not appropriately followed), and if the measures were appropriate to the requirements of the National Guides.

6.3.1 Factors influencing the choice of measures (design)

According to many of the interviewees, one of the factors which influences the design of the measures, rather than following the mitigation hierarchy, is that they are based on previous experiences, not because they are certain that the measures have worked in the past, but because they know that the authority have previously approved those measures. In this regard, developer D1 stated that *'for us the most important thing is to adjust according to the reality and the experience that previously we had* [referring to a previous planning permission granted] *and that also indicates which are the measures that we know that are more complex and that we have to reinforce some additional follow-up measures for the success of these measures'*. Following this, developer D2 admitted that *'there's no need to reinvent the wheel, so, one looks at the state of the art, how other projects that have RCAs* [permission granted] *have been, one takes that as part of the previous analysis and from there one starts developing the environmental assessment of the project'*. Developer D3 also agrees: *'we are not going to get creative with something or try to implement something that might come up as an idea, it is very risky, it is very risky for this type of project, therefore we always comply with what is regulated, with what the regulations ask of us'*. Consultant C1 argued about the common measures that

are found in the environmental reports, such as relocation and rescue, and controlled perturbation for fauna, and revegetation, and relocation and rescue for flora: *'there are standard measures that are the typical ones and that are normally proposed in EIAs* [environmental report] *and that are implemented by the developers'*. Evaluator E1 also recognises that *'there are standard measures'*.

Another factor that emerged as being considering when proposing measures, was the cost of the measures. Consultant C2 pointed out that *'one has to comply, but we have to manage to achieve compliance in the cheapest way'*. Consultant C3 also agrees that *'ultimately the deciding factor, in term of costs, is the resources that are committed to this activity'*. For developer D2: *'There are two factors that are key for me, one is the economic factor, which is undeniable. And the economic factor is also directly related to the difficulty of implementation of the measure'*. Also, developer D3 added that *'obviously other things are going to be evaluated, for example for a developer it is related to the budget'*.

The interviewees also discuss the fact that incomplete design favours the proposition of compensation measures. As usually developers do not have the final design of the project, they prefer not to commit to measures within the area of influence since it is not definitive, so they propose compensation measures to be carried out outside the area of influence of the project. Consequently, consultant C1 expressed that the developers *'prefer not to commit an area within the area of influence because they don't know whether they are going to use it, or maybe they're not going to be able to implement mitigation and repair. So, they prefer to move on, immediately to compensation'*. When developers were consulted about the compensation measures that were proposed for their projects, developer D2 stated that *'there are components* [biodiversity] *that I know from the beginning that I'm going to have to compensate, because it's going to depend on the nature of each project'*, and developer D3 added that *'I think the compensation measures that were defined were appropriate for this type of project. Maybe there was no need for a repair measure'*.

From the interviewees, two consultants argued that there are specific habitats that cannot be mitigated or repaired, therefore they have to opt for compensation measures straight away. Consultant C2 claimed that *'if the project impact is habitat loss, then how can you mitigate or repair habitat loss? you cannot'*. Consultant C3 justifies that *'there were components that were significantly affected, which were flora and fauna. So, compensation was made, because the*

[EIA] *system and the national guide obliges us to compensate'*. This is related to the fact that some projects cannot avoid or repair the impacts on biodiversity, as discussed in Section 5.4.

Finally, one consultant raised the issue of specific impacts that cannot be compensated. In this case in particular, C3 was concerned about specific elements of the biodiversity that it is impossible to compensate: *'It becomes a bit practicable, indeed it becomes in some cases a bit impracticable* [compensation]*, because finding an area outside the area of influence and proposing measures or activities to compensate, for example, the loss of Chinchilla communities, I don't know, short-tailed chinchillas, I don't think it's possible'*, raising the issue of the need to consider limits to compensation.

6.3.2 Constraints influencing the implementation of measures

When interviewees were asked about the measures proposed for the projects, additionally to the design of the measures they also referred to the implementation of the measures post-approval of the projects. Therefore, some constraints that influence the implementation of the measures were identified. For instance, that operating conditions determine the practicability of the measures. Issues such as company safety standards, community relations, complexity of implementation of measures in practice, were raised by the participants. In this regard, Consultant C1 commented that *'many of the measures were difficult to implement in practice … so nowadays, in the design of the measure, beyond the technical aspect, the operational factor is incorporated into the design* [of the measure]*'*, and added: *How are you going to get to the reforestation area? Are we going to build roads? Which standard? Are we going to have an automated irrigation system, non-automated? Our technician will only tell you that revegetation needs irrigation … but all of that is what we start to discuss with this operating group'*. Developer D1 mentioned that *'measures appropriate to the site* [have to be] *corrected to the reality of the intervention area … We have prior knowledge of what can and cannot be implemented'*. Developer D2 affirmed that *'often the authority is very demanding and also unrealistic, in some cases, in order to make a counter-proposal to a proposal from a developer, and the company has to be very pragmatic in that sense, because I could promise a very attractive measure that the authority likes very much, but in the future, when I have to implement it, it will be impossible, because the conditions are not right because, I don't know, there are an infinite number of variables'*. Developer D3 also added that the measures must be *'manageable from the point of view of being able to implement and to be able to achieve the*

objective, basically. Because why am I going to commit myself to something that in the long term can generate more of a problem than a benefit?'.

Other constraints detected in this study were that, in some cases, external factors prevent the correct implementation of measures, in terms of weather (rain/drought), especially availability of water. Consultant C1 stated that *'we also have to understand that these projects are inserted in territories that also have their own realities. So, in fact* [the project] *at some point questioned, hey we are spending a lot of water to irrigate these plants and on the other hand we have communities that don't have access to water'*. Developer D1 pointed out that *'there are factors that generate more risks … mainly related to drought. There is an external process rather than direct intervention of the operation, which is mainly related to climate change'*. Developer D3 addressed logistics: *'During the process, because the paper supports a lot, I mean, the paper tells you you have to do it this way, there is a methodology, everything is applied, it is done, but there are also complex things that have to be managed during the implementation itself. For example, the transfer of species. You can't spend two hours* [transferring the species]*, and suddenly you do the rescue, and you get a traffic jam, and you don't comply with the two hours'*, and weather: *'We were relocating species in an area that was approved, it was reported and everything … and in winter we had three floods of the river … So that area where we were relocating was lost'*.

In terms of the lack of repair measures detected in most of the 31 EISs studied in Chapter 5 (case studies), developers and consultants were asked if they think that compensation measures were prioritised over repair measures, and they mostly agreed that in certain cases, the area of influence does not allow the implementation of repairs. Consultant C1 responded that *'if you have the work installation, and you cut everything down, there is no possible reparation because you have already destroyed the resource'*. Consultant C2, when asked about the specific measures in the project, pointed out that *'they were all originally intended as a reparation measure, however due to the impact assessment it was not possible to implement in the area of influence so we had to compensate in an area that is very close to the area of influence'*. Developer D3 also referred to the lack of repair measures in the project: *'Repair also involves many other activities, and you have to have a suitable environment and also be able to implement more resources of all kinds in order to be able to achieve a repair, I mean, that's why I think the tendency is also towards compensation, especially for the developers'*.

In the experience of monitoring officer M2, monitoring projects post-approval decision, there is a poor implementation of the measures in the practice: *'The measures may sound very good on paper, but when you go to analyse them and when you start to monitor the execution of the measure as such, the execution is very bad'*, and added: *'they are* [the measures] *badly implemented'*.

6.3.3 Mitigation hierarchy is not followed

One issue detected from the interviews related to the mitigation hierarchy was that there is a lack of understanding of what is implied by each of the measures in the hierarchy, which causes misclassification of the measures. Consultant C1 explained that *'for example, rescue and relocation, was sold as a mitigation measure, that's my interpretation. The narrative that mitigation can also be for the environmental component was sold. However, the definition of mitigation is basically to minimise the effect of your project, not to move the environmental component'*. Consultant C2 argued that they proposed a scientific study of a lizard species as a compensation measure: *'We did propose, in that case, to do a home range study of Lemniscatus in a protected area as a compensation measure'*, also added that *'it was as a contribution to the knowledge of reptiles and at least we were going to have some long term basic ecology, so later on we could manage the same species. But I totally agree that it's impossible to quantify it* [as a compensation measure]*'*. Consultant C3 expressed that *'looking at other assessments, I see that the concepts are sometimes confused. They propose measures such as mitigation instead of compensation or reparation instead of compensation, and they try to enter* [to the EIA system] *in that way'*.

Finally, a couple of interviewees spoke about the lack of effort to follow the mitigation hierarchy. Consultant C3 stated that *'at that time, not only for this project, but for many more, the tendency was, in a way, not to follow this hierarchy... Looking also at other studies at that time, generally the measures go from mitigating to compensation, they don't do an analysis* [of the mitigation hierarchy]*'*. Developer D2 admitted going for compensation without the analysis of the hierarchy mitigation: *'All my measures are aimed at compensating rather than repairing … so as part of that exercise we always try to go for compensation because we try to minimise the impact that the project generates'*.

6.4 Achieving biodiversity NNL

The interviewees were asked whether they think the measures proposed adequately delivered biodiversity NNL, considering the projects they were working on (developers/consultants) or in their experience reviewing projects (evaluators/reviewers/monitoring officers).

6.4.1 Failure to quantify biodiversity loss

One of the reasons for the failure to quantify biodiversity loss extracted from the interviews was that NNL could not be verified. Many of the interviewees were sceptical that projects could achieve NNL. Consultant C1 said *'I could not tell you whether the zero net loss target has been achieved today ... because there is no full tracking of the gains'*. In the same regard, consultant C2 admitted that *'I don't think any project in Chile can achieve this today. You can quantify it a bit ... and you can quote the Guide and you can say there is zero* [net loss]*, but I don't think so'*, and also added *'I think that the consultants, the companies that have come to demonstrate this zero biodiversity loss, I don't know, I doubt it. I think it's a package that has been arranged to give you zero. So, as biology is so variable, I could say anything'*. Consultant C3 commented that *'I don't think so, I don't think that the measures were* sufficient [to achieve NNL]*, not only the projects we saw, but also projects we saw from other developers. But currently I see that an effort is being made, but I would say before 2022, it was very low'*. Developer D3 explains that they are not aware if the project meets the parameters for quantifying biodiversity NNL because they justify in the monitoring reports what they have done, but in practice, there is no certainty: *'So, if you ask me today if the measures in the guide were efficient, I can't give you the answer because I don't know'*. Evaluator E1 expressed that measures are implemented but that is different from verifying the success of the measures: *'although it is not verifying zero net loss, it is verifying that the measure is implemented'*. Monitoring officer M1 argued about the lack of information about monitoring NNL, in terms of methodology, sampling effort, and parameters: *'I doubt that very much if anywhere it says that the biodiversity net loss has to be 0, with the level of information that was in that report and that we checked against, I assure you it's not there'*.

Many interviewees also expressed their concern that the quantification of impacts is being based on proxies for biodiversity, quantifying the elements of the biodiversity separately (i.e. fauna, flora). Consultant C1 argued that *'the aim of the guides is that you analyse biodiversity, which is far more complex than the different components of the environment ... So, when we*

apply the 2014, 2022, 2023 guides, you analyse all of this at the biodiversity level, but you still end up analysing the impacts by component, and you end up offering measures by component', and consultant C2 added that: *'there is no compensation in terms of ecosystem'*. Consultant C3 acknowledges that in the updated guide *'An attempt is being made to establish in some way, to take these metrics, but to integrate diversity, not only plants and animals'*, and developer D1 argued about their attempt to integrate different components of biodiversity in the measures: *'We proposed a comprehensive plan for plant, animal, soil, which integrates different components and establishes a more appropriate measure'*. Reviewer R2 expressed concern for components of biodiversity that are not being considered because *'the systemic approach does not appear in the environmental assessment, even when they say it, they define it, there is no instance of integrating everything'* and added: *'So, the big flaw is that you are not necessarily taking care of everything that is being lost'*.

Two interviewees referred to the fact that in some cases it is difficult to quantify biodiversity loss. Consultant C2 said in this regard that *'biodiversity is not static, it moves and changes, there are dry years, there are wet years, so how can we consider a loss of biodiversity in such a dynamic environment? I mean, if you give me the numbers, I can quantify it, of course ... but, it doesn't really work like that'*. Reviewer R2 acknowledges that *'indeed, at least in the last few years we have worked with indicators that are more quantitative. But even so, the observation is whether or not the number of* [biodiversity] *affected is well calculated'*.

6.4.2 The measures are not aimed at achieving NNL

In terms of the measures designed to achieve NNL, many of the interviewees commented that they had a low probability of success, as they are not trying to achieve NNL. For instance, consultant C1 commented that *'for wetlands, in the past it was proposed the rescue and relocation of wetlands, which we now know is a measure with a very low probability of success'*. Consultant C2 also referred to this: *'Definitely, rescue and relocation is what you do today, but no one can say for sure if it works at all'*. Developer D3 added for the same measure of rescue and relocation that *'sometimes it is difficult to prove that a species that you took from one place, brought to another, it survived, that it is the same specimen that you rescued ... And there, the measure cannot be successful'*. Moreover, Reviewer R2 expressed that *'we know that there are measures that do not work, rescue and relocation is a measure that has zero impact to deal with the impact on fauna'*, and also argued that *'Why does it continue to be approved? First, because developers and consultants are already proposing it, so they ensure post RCA*

[planning permission] *work … and it is easy to do and everybody does it, it has been copied from the beginning. But when you get into the technical debate, everybody knows that the measure doesn't work'*. In this regard, monitoring official M2 argued that *'there is a need for a review of the measures established in the RCAs* [planning permission]. *Why? Because many measures do not really achieve the objective, neither zero net loss nor additionality'*.

A couple of interviewees addressed the issue that some measures were targeted only at species with conservation status (category assigned to species to reflect its risk of extinction). In this sense, consultant C2 argued that *'mitigation, repair, and compensation measures are aimed at species in conservation status, not at the service the species may provide within a site'*, and added: *'we talk about ecosystem services, for example, those two shrubs are not really in conservation status, but they provide an ecosystem service of food, shelter, reproduction and a lot of other things, however, nobody asks about them because it is not an issue … the guide tends to quantify, but only the species in conservation status, and that is only one part of the problem'*. Developer D3 explains why there is only concern about species with conservation status: *'In this case, when we talk about implementing compensation, it is because species in conservation status are affected, in other words, it is not all the species that may exist in the place, we always focus on target species. Why? Because they are more sensitive species'*.

Another issue that was addressed by a couple of interviewees was the lack of compensation measures based on restoration. For instance, consultant C1 said that the *'other option is restoration measures, not repair measures, but restoration measures, which basically seek an improvement in the condition of your compensation area through measures to revegetate, relocate, and there you use the metrics and evaluate'*. For reviewer R2: *'Within a comprehensive plan, everything that is restoration and threat reduction is what effectively contributes to the process of gains'*.

Finally, one interviewee referred to the difficulty to compensate high biodiversity value areas, thinking specifically in the Chilean context: *'It is very difficult to compensate areas that have too high a value in terms of biodiversity … places like Patagonia, which have an important amount of diversity, or coastal places in the north of Chile, also biodiversity hotspot regions, there I see it as almost impracticable'*, highlighting the need to reconsider whether compensation is a viable strategy in such cases.

6.4.3 Lack of scientific knowledge

A theme extracted from interviews in terms of achieving biodiversity NNL, was the lack of scientific studies and background necessary for the assessment process. A few interviewees raised the lack of basic knowledge on biodiversity ecology as an issue when trying to propose measures. Consultant C1 said in this regard: *'Always in the environmental assessment, unique species come out and you don't know how you are going to reproduce them* [in a nursery for the compensation measures]. *There is no study, you have to do trial and error and that takes time'*. Consultant C2 explains that *'that is the great flaw of Chile and for all the natural resources that we have to manage. There is a lack of basic ecology, so it is impossible for us today to manage'*. Developer D3 talked about the lack of specialists: *'It is difficult to find a specialist in repair* [biodiversity]*... There are universities, there are other organisations that are not state bodies that are also dedicated to studies, but I think there is a lack of research and I think Chile is a bit weak in that sense, that's why many people go to another country to do many things, because here it's very limited'*. Following the same issue, reviewer R2 said that *'we are still with the concepts of classical ecology, so we are far from incorporating them into the EIA process'*.

6.4.4 Inadequate quantification of impacts

As part of the environmental impact assessment process, the quantification of impacts is essential to achieve biodiversity NNL. In this regard, some concerns were identified by a few interviewees. In the first place, the lack of studies on cumulative impacts. Monitoring officer M2 expressed that *'so far, there has been very little study of the synergy effects generated by the implementation of several projects'*. Secondly, the issue that baselines are not adequate to quantify impacts. Reviewer R2 said that *'it will depend on the complexity of the ecosystems, on what you are working with to see if the baseline is enough… Therefore, one starts from the premise that, indeed, the impacts are well quantified, that is where we suddenly find some problems'*. Along the same lines, monitoring officer M1 explains that *'characterising an area in terms of biodiversity has a multiplicity of species that you don't even know if they are classified… Or you don't know how to identify it, because you can see it in different stages, you can see a footprint, you can see an egg, you can hear a bird, so that's why you have a lot of additional complexities'*.

6.5 Effectiveness of the monitoring

In Chile the monitoring is mandatory for all the projects which have declared significant impacts and is the responsibility of the *Superintendencia de Medio Ambiente* (Superintendency of the Environment) which executes, organises, and coordinates the monitoring, that is established in the environmental reports. The participants were asked whether they think the monitoring proposed for the projects adequately evaluated the achievement of biodiversity NNL.

6.5.1 Need for more comprehensive monitoring strategies and quantitative indicators

The necessity of having more comprehensive monitoring strategies and quantitative indicators was indicated by most of the interviewees. Firstly, the issue of the lack of quantitative success indicators was raised. Evaluator E1 considered that *'the indicators that must be monitored to prove that the measure is being applied in the way it was assessed in the environmental impact study need to be specified'*. Similarly, monitoring officer M1 expressed that *'if for some reason it cannot be calculated* [the effectiveness of the measure], *it is because they simply did not report all the information that should have been reported'*, and monitoring officer M2 added that *'there are no means of verification or indicators of compliance, or monitoring, I find, as adequate to be able to define whether or not the objective is actually being achieved'*. Reviewer R1 also pointed out this: *'Many times the indicators that are proposed are very bad and very vague, so it is difficult* [to verify]. *The indicators have to be quantifiable, they have to be measured over time, so that's where I think sometimes it's a bit difficult to ensure that the measure is successful'*, and reviewer R2 indicated that what *'we are doing as a reviewer is to ask for clearer indicators* [of success]'.

Secondly, the interviewees felt that monitoring focuses on a limited range of biodiversity elements, for example consultant C1 said that '*more than the survival of a certain floristic composition, or a revegetation, you have to commit to a gain in biodiversity, and it is not the same thing, because your gain is related to cover, composition, more than just survival*'. Consultant C3 also agrees that *'the monitoring assesses only certain elements* [of biodiversity]*'*, and developer D2 indicates that *'the indicators of success are quite simple, basically it is whether the plant lives or not'*.

Thirdly, two interviewees considered that it is difficult to monitor microfauna, therefore it is challenging to verify the success of the measures in this group of fauna. Consultant C2 explained that *'I don't know what I'm monitoring on the day of monitoring, whether it's individuals from the previous population or just new ones'*, and developer D3 commented about the monitoring on microfauna: *'I think it is a difficult task, difficult to demonstrate. And the specialists try to do it, because you have to comply with the percentages and a lot of things, but I think that in practice, the methodology, it is difficult to demonstrate compliance'*.

Finally, consultant C3 talked about monitoring being too short term: *'I think* [the monitoring] *was very short term what one set out to do'.* This highlights a key issue, in that whilst the monitoring complied with the minimum requirements set by the authority, it was not designed in a way that would effectively verify biodiversity outcomes.

6.5.2 Inadequate monitoring practices

This theme emerged when many of the interviewees, especially the monitoring officers, talked about some practices in the monitoring which do not allow verification of achievement of the effectiveness of the monitoring in terms of achieving NNL. The first one was the lack of monitoring data to verify NNL. For the monitoring being verified by the Superintendency of the Environment, the developer of the project has to deliver a report detailing the progress of the measures implemented. In this regard, monitoring officer M1 commented that *'the monitoring planning established in the RCA* [planning permission] *should be very clear with all the information that the developer should deliver, so the SMA* [Superintendency of the Environment] *can take this and say whether there is or there is not zero net loss of biodiversity… but for that you need to have the primary information that allows you to do the calculations'*. Whereas monitoring officer M2 explains that *'monitoring reports are still poor, as in quantity and quality of information, especially in terms of quality'*.

Another point noted by a couple of interviewees was that in some cases, the implementation of the measure is reported, instead of the biodiversity outcome. Hence, the monitoring report informed the success of the measures based on its implementation, rather than the effectiveness of the measure in terms of biodiversity outcomes (Cares et al., 2023). With respect to this, consultant C3 explains that there is no verification beyond the report: *'the monitoring milestones sometimes is the fact of going to monitor, it is a report, a report is the milestone of going to see'*, and monitoring officer M1 said that *'everything is reported, but without a*

methodology' so it is difficult to verify the success of the measure. Also, monitoring officer M2 argued that *'if you look at the RCAs* [planning permission] *some of the compliance indicators are quite illogical: "A report will be sent". And that is the compliance indicator for a rescue and relocation measure'*.

Additionally, the monitoring officer M1 pointed out that low levels of standardisation of the measures complicates effective monitoring efforts, because '*it makes each element very different, standardisation and generalisation are very low, so there is a lot of burnouts in the* superintendence'. This highlights the challenge of ensuring consistency and efficiency in monitoring planning, as the monitoring officers from the Superintendency of Environment are not involved in the impact assessment process and, therefore, are unable to influence or modify any aspects of the approved monitoring plan.

6.5.3 Lack of staff capacity for fulfilling monitoring tasks

A few of the interviewees referred to the fact that there is a lack of staff capacity for fulfilling monitoring tasks, starting with the insufficient number of monitoring officers. In this regard, consultant C2 argued that *'in Atacama there are two officials from the Superintendency of the Environment and it is the region with the highest number of mining projects, in other words, these reports are going to be lost in absolutely nothing. Nobody is ever going to read them, ever'*. Developer D3 expressed that *'I think there is a lack of specialists for monitoring'*, and monitoring officer M1 also acknowledges that *'there is a lack of capacity in the SMA* [Superintendency of the Environment]*'*.

As the people involved in the environmental assessment process (evaluators and reviewers) are different from the people in charge of the monitoring (monitoring officers), a few interviewees argued that the fact that the authority reviewers were not involved in the monitoring becomes an issue post approval decision. For example, developer D3 expressed that *'their involvement stops there* [the participation of the reviewers]*, and then the same people who review [in the assessment process] don't follow up afterwards'*. Evaluator E2 acknowledges that *'it corresponds to the SMA* [the monitoring] *because we do not verify if they are successful or not* [the measures]. *The fact that we do not evaluate projects ex post, and the SMA does not review projects within the assessment process, it can be seen from some perspectives as a flaw'*. Monitoring officer M2 added that *'the level of incidence by the services* [reviewers] *in terms of monitoring is only just beginning'*.

Finally, monitoring officers referred to the lack of feedback between the relevant authority in charge of the assessment process, especially with the evaluators. Monitoring officer M1 said in this regard: *'We have the empirical knowledge of the measures that should be more requested and the measures that… do not work. That knowledge should somehow be transferred to the Environmental Assessment Service and all its evaluators'*, and monitoring officer M2 added that *'there is still no such a work together between the two services* [Environmental Assessment Service and Superintendency of the Environment]*, where there is some kind of feedback, to said we need to improve these measures and from the evaluation it can be done and incorporated'.*

6.6 Discussion

This chapter has presented the results of the thematic analysis of the semi-structured interviews conducted with stakeholders involved in the EIA process in Chile, to explore their experience in the implementation of compensation of biodiversity (offsetting) in the Chilean practice in relation to national obligations, stated as the second objective of the thesis. The discussion that follows interprets these findings in light of the research objective and the existing literature, highlighting the contributions and implications of the study.

One of the key themes that emerged was the **'use of the 2014 guide and the National Guides (2022-2023)'**. Participants referenced the National Guides created to standardise the design of the compensation of biodiversity, indicating its significant improvements in the most recent version, especially by the incorporation of a methodology to quantify impacts on biodiversity (SEA, 2023a). While the National Guides provide a valuable framework for ensuring that compensation measures are aligned with biodiversity conservation goals, several interviewees, especially consultants and evaluators, raised concerns about its practical application by the relevant authority. They noted that authorities in charge of reviewing the environmental impact studies (reviewers) not always followed the guidelines established in the National Guides and also acknowledged a lack of expertise of the evaluators, leading to varied interpretations and inconsistent implementation across different regions. In this regard, ten Kate et al. (2004) also found that regulators often face challenges in applying specific regulations for biodiversity offsetting effectively. These issues highlight the need for greater adherence to, and training on, the National Guides to ensure more effective and uniform implementation of biodiversity compensation measures.

Another significant theme was **'adherence to the mitigation hierarchy'**. The mitigation hierarchy, which prioritises mitigation and repair of biodiversity impacts before considering compensation (SEA, 2014, 2022), was widely acknowledged by the interviewees as a fundamental principle guiding biodiversity compensation. However, the data revealed significant challenges in its implementation. Consultants reported that in practice, the hierarchy is not always strictly followed, due to a lack of analysis to justify the mitigation hierarchy levels. This finding aligns with the results from the quantitative analysis in Chapter 5 (Section 5.2), where it was observed that while the mitigation hierarchy is widely endorsed, its practical application in Chile often falls short (Cares et al., 2023). Developers and consultants agreed that there are different factors influencing the design of the measures, rather than following the mitigation hierarchy, such as previous experience of measures that were approved, costs of the measures, and the perceived ease of implementing compensation. This is consistent with Hayes and Morrison-Saunders (2007) who concluded that the mitigation sequence is not always fully implemented, suggesting that the implementation does not meet the theoretical expectations. This study contributes new insights by documenting the specific barriers to following the hierarchy, such as inadequate enforcement mechanisms and competing priorities during project planning. These barriers lead to a scenario where the prioritisation of mitigation and repair is compromised, resulting in biodiversity compensation being used as an alternative rather than a last resort. These findings suggest the importance of reinforcing the hierarchy in both policy and practice (McKenney & Kiesecker, 2010), ensuring that it serves as a guiding principle rather than a mere formality in the environmental assessment processes.

A third theme was **'achieving biodiversity NNL'**. While the Chilean policy framework for biodiversity offsetting is explicitly designed to achieve NNL, or if possible, BNG, participants expressed scepticism about whether these outcomes are being achieved in practice. Consultants were particularly concerned about the metrics used to calculate losses and gains of biodiversity that often fail to capture the full complexity of biodiversity and questioned the probability of success of the measures as NNL could not be verified, leading to offsets that may not fully compensate for the losses incurred by development projects. They also mentioned that in some cases due to irreplaceability or biodiversity hotspots, NNL could not be achievable. This issue has been highlighted by Maron et al. (2012), who questioned the feasibility of achieving NNL through current offsetting practices, due to poor measurability, long time lags and uncertainty of the offsets. The present study reveals the practical difficulties encountered by practitioners, including challenges in defining baselines, ensuring the equivalence of biodiversity gains and

losses, and addressing long-term ecological changes. These challenges suggest that while the policy aims for NNL, verifying and achieving these outcomes remains difficult, emphasising the need for improved methodologies and monitoring to ensure that compensation measures genuinely fulfil their biodiversity purposes.

The final theme **'effectiveness of monitoring'** highlights the crucial role of monitoring in ensuring that biodiversity compensation achieves its intended outcomes. Participants widely agreed that effective monitoring is essential for evaluating the success of compensation measures and ensuring accountability. However, this study revealed significant limitations in current monitoring practices. Consultants and reviewers raised the issue of more comprehensive monitoring strategies and quantitative indicators, whilst monitoring officers argued about inadequate monitoring practices proposed in the environmental impact studies. Monitoring officers mentioned that monitoring is often inadequately implemented, leading to gaps in data and uncertainty about whether offsets are delivering the expected NNL. These findings are consistent with the concerns raised by Bull et al. (2013) and Moilanen et al. (2024), who emphasised that rigorous and ongoing monitoring is needed to assess the effectiveness of biodiversity offsets. The present study extends this discussion by identifying specific factors that challenge monitoring efforts, such as the lack of standardised monitoring practices and quantitative success indicators, and the challenge of verifying biodiversity NNL.

In summary, the analysis of the semi-structured interviews highlights several critical findings regarding the implementation of biodiversity offsetting in Chile:

1. The evidence suggests that adherence to the mitigation hierarchy remains very low in practice. Many mitigation efforts rely on established practices or generic solutions, rather than being tailored to the specific ecological and project contexts, which undermines their effectiveness in addressing unique biodiversity challenges. Furthermore, there is a notable absence of analyses to justify the level of the hierarchy applied in specific cases, raising concerns about whether the mitigation measures chosen are appropriate or optimal for the impacts being addressed.
2. The findings indicate that the design of mitigation measures is frequently driven by cost considerations and constrained by a lack of expertise, undermining their effectiveness. This tendency appears to stem from systemic elements within the EIA framework that

emphasise compensatory approaches, potentially because they are perceived as more straightforward or cost-effective to implement.

3. Considerable uncertainty persists regarding the achievement of NNL, raising significant questions about the reliability of current approaches. One key reason for the difficulty in quantifying biodiversity loss is that NNL cannot be effectively verified. This uncertainty is further complemented by the inadequate implementation of monitoring systems, which often fail to provide accurate or comprehensive data on the effectiveness of mitigation measures.
4. Poor monitoring limits the ability to assess whether NNL is being achieved or if implemented measures are meeting their intended outcomes. While the monitoring complied with the minimum requirements set by the authority, it was not designed to effectively verify biodiversity outcomes, highlighting a key issue in its effectiveness. Furthermore, this situation underscores the challenge of ensuring consistency and efficiency in monitoring planning.
5. An issue identified was the inconsistencies between the guidance provided by authorities and the standards outlined in the National Guides. These inconsistencies can result in binding requirements for developers that are misaligned with best practices, creating confusion and inefficiencies in the implementation of biodiversity offsetting measures. This highlights a critical gap in capacity, as the lack of clear, consistent revisions from authorities undermines the ability to effectively apply biodiversity offsetting principles.

Chapter 7 Identifying opportunities for improving EIA biodiversity outcomes in Chile (objective 3)

7.1 Introduction

This chapter outlines the qualitative findings associated with the third objective of the thesis 'to identify the opportunities for improving biodiversity outcomes in Chile', aimed at addressing the research question 'How can the EIA System in Chile help to achieve no net loss of biodiversity?' A focus group was conducted to collect views and expert opinions on the assessment process of the EIS (Fonseca et al., 2017), from the perspective of stakeholders involved in biodiversity compensation throughout the entire EIA process. Additionally, supplementary individual interviews were arranged with the stakeholders who could not attend the focus group, combining both methods in the analysis (Lambert & Loiselle, 2008).

The following sections are organised around the key findings that were extracted from the analysis of the semi-structured interviews presented in Chapter 6 (Section 6.6). These themes were used to structure the focus group to ensure the themes emerging from the interviews were all considered, and then inductive coding was used to identify emerging themes and insights from the participants:

1. Better implementation of the mitigation hierarchy;
2. Effective implementation of mitigation measures in practice;
3. Improving certainty NNL;
4. Improving monitoring; and
5. Strengthen capacity

Although the interviews revealed certain challenges and constraints associated with biodiversity offset practices in Chile, in accordance with national obligations (as discussed in Chapter 6), the present analysis offers a comprehensive understanding of the opportunities for enhancing biodiversity outcomes through the EIA System in the country. Each theme is presented with supporting quotes from the participants in the focus groups/supplementary interviews to illustrate the viewpoints of the stakeholders (

Table ***7.1***). The quotes were translated into English by the researcher conducting the interviews. As a native Spanish speaker, the researcher was able to translate all the text and terminology into English accurately. The original text in Spanish can be found in Appendix 9.

The focus group was attended by just two out of seven stakeholders who initially agreed to participate (the others withdrawing just prior to the event); one being an environmental consultant (C) and the other a monitoring officer (M). Supplementary one-to-one interviews were subsequently conducted online with the five stakeholders that withdrew from the focus group, including an officer from the Environmental Assessment Service (E), an officer from the Environmental Ministry (A), two specialists who prepared the national guides (SEA, 2014, 2023a) (G1 and G2), and one NGO involved in citizen participation (N).

Table ***7.1*** sets out the thematic analysis of the combined results from the focus group of two individuals, and subsequent interviews with five others (n=2+5=7). Each of the themes is discussed in turn after the

Table ***7.1***.

Table 7.1 Results of the thematic analysis

Themes	Codes	Number of participants (n=7)	Stakeholder	Number of references
1. Better implementation of the mitigation hierarchy		**6**		**30**
Strengthen the first steps of the mitigation hierarchy		**6**		**19**
	Discourage compensation measures	5	C, M, A, G1, G2	6
	Encourage avoidance measures	4	C, E, G1, G2	4
	Incentives to analyse project alternatives	3	C, M, A	4
	Providing information on alternative measures to compensation	2	C, M	4
	Categorise compensation measures by project type	1	M	1
Following the guidelines in the National Guides thoroughly		**6**		**11**
	Incorporate ecosystem approaches	3	E, G1, G2	5
	Making explicit the use of the mitigation hierarchy	4	C, M, A, G1	5
	Using the matrix of key components included in the national guide	1	A	1
2. Effective implementation of mitigation measures in practice		**3**		**7**
Effective implementation and accountability mechanisms		**3**		**5**
	Ensuring effective implementation of the measures as designed	2	C, M	2
	Traceability of the measures in the planning permission	2	C, A	3
Comprehensive design of the measures		**2**		**2**
	Properly establishing the area of influence of projects	1	A	1
	Determine measures related to the size of the project	1	C	1

Table 7.1 Results of the thematic analysis

Themes	Codes	Number of participants (n=7)	Stakeholder	Number of references
3. Improving certainty of NNL		**5**		**10**
Adaptive management and continuous improvement		**4**		**10**
	Implement adaptive management	2	M, G1	2
	Collect/compile knowledge of measures that are not working	2	C, M	4
Strengthened compliance and precautionary principle		**2**		**4**
	Improving penalties for non-compliance	2	G2, N	3
	Incorporation of the precautionary principle	1	N	1
4. Improving monitoring		**4**		**5**
Enhancing clarity and communication in monitoring		**4**		**5**
	Clear monitoring set out in the planning permission	2	M, E	2
	Improve how monitoring results are presented in the reports	2	A, N	3
5. Strengthen capacity		**6**		**31**
Institutional capacity building		**6**		**24**
	Assessing Evaluators	3	G1, G2, N	7
	Improving training for regulatory Authority	5	C, A, G1, G2, N	11
	Learning by doing	3	A, E, N	6
Collaboration and consultant selection		**4**		**7**
	Encouraging collaborative work with the private sector and universities	1	E	3
	The State should select the consultants based on objective criteria	3	G1, G2, N	4

7.2 Better implementation of the mitigation hierarchy

7.2.1 Strengthen the first steps of the mitigation hierarchy

Participants outlined several strategies to facilitate the effective implementation of the mitigation hierarchy with a primary focus on reinforcing its initial steps, for example, encouraging avoidance measures. Participant E declared that *"the idea is that the developer,*

with their consultants, design a project that already includes minimisation and mitigation measures in its design, so the impacts that we evaluate are those that are unbridgeable, that we don't have the technology, we have no way of moving the project… So that is why the design stage is critical to narrow down the impacts that we are going to have to mitigate, repair or compensate for". In the same regard, participant G2 refers to the fact that *"if you apply the methodology and come up with something as impossible to do as compensation, then it should automatically incentivise the application of the mitigation hierarchy and that impact should be avoided"*. Participant G1 expressed that when a project fails to stipulate in their assessment process whether they avoided impacts, they *"miss the opportunity to assess whether prior mitigation efforts have actually been made"*, highlighting the importance of presenting this step of the mitigation hierarchy.

Additionally, the participants expressed that compensation measures should be discouraged as a means of strengthening mitigation and repair. Participant C said that *"if the mitigation hierarchy were actually prioritised, it would mean that compensation measures would have to be reduced"*. The idea is to discourage compensation measures because it has to be expensive for the project: participant A said that *"the idea is to promote mitigation and repair rather than compensation, compensation does not have to be cheap because it is expensive"*, whilst participant G1 stated that *"compensation measures can be cheap in the short term, but complicated in the long term because they do not work, because they are very expensive to implement, sometimes they are unfeasible to implement"*, and participant G2 added that *"compensation has to be expensive, if it is not expensive, there will never be a real incentive for not to compensate. If it is cheap to compensate, obviously they are going to do it, but it is cheap because they* [compensation measures] *are poorly designed, and poorly assessed measures"*.

The participants also talked about the possibility of analysing project alternatives in terms of location, depending on its impacts and the costs of the compensation measures, because *"today there is no incentive for the project to analyse alternatives"* according to participant C, although this participant also acknowledges that *"linear projects have a higher probability of analysing alternatives, but for areal projects, the mining site is there, they have no way to move to another location"*. Participant A agrees that *"the costs* [of the compensation measures] *should be a disincentive to the proponent to develop the project in that location"*, and added: *"the national guide leaves the decision to the developer based on how expensive it will be* [the

compensation measures]*, and it is expected that the more expensive it is, the more disincentive there will be to locate the project there"*.

A couple of participants argued about the role of the Environmental Assessment Service in providing information on measures that were alternatives to compensation. In this regard participant M stated that *"if the developers are not provided with alternative measures that are not compensation measures, but rather from the other stages in the mitigation hierarchy, there are no economic incentives for them to explore different alternatives. You need an assessment of the design and implementation of the measure, in order to have feedback into the design and proposal of measures"*. Participant C added that: *"You often ask the agencies* [involved in the assessment process] *what alternative do we have? And they don't know. They say that you propose it"*.

Finally, participant M raised the categorisation of compensation measures by project type, explaining that *"you could generate a typology of projects, knowing in which typology of projects compensation is the logical way, against another projects that it really is not*".

7.2.2 Following the guidelines in the National Guides thoroughly

A number of participants highlighted some specific content of the national guides that could lead to a better implementation of the mitigation hierarchy, if followed. For instance, making explicit the use of the mitigation hierarchy during the assessment process. Participant M proposed that *"it should be expected* [to see] *an explicit statement from the developers if they are proposing a compensation measure: I tried to avoid but it can't be done, and why"*. Participant G1 agrees that *"the Environmental Assessment Services should ask the consultants which are the mitigation measures, even if they have been prior to the submission of the* project [to the assessment process] *and which are the repair measures. If there are no repair measures, it has to be explicitly stated"*. Participant A expressed that *"the mitigation hierarchy must be applied, I believe that one of the most important objectives is that it must be applied, because otherwise we will be affecting all ecosystems irreversibly"*.

By incorporating the ecosystem approach, some participants argued that the measures could be better determined in terms of the impacts on biodiversity. Participant G1 considered that "*if I define the focus of a measure to be an individual of a species, I am avoiding the impact on the individual, but there is still an impact on the species or the population. Therefore, you need to*

think whether the impact it is about the species, the population, or the ecosystem". Participant E explained that *"both the consultants and the evaluators have to see this as an ecosystem and as a whole, in general they all see flora, fauna, vegetation, and they do not manage to see the whole impact assessment in the ecosystem but do it by component"*. Participant G2 added that: *"This has to be seen in terms of habitat and not in terms of fractions, not the lizard separated from the fish, separated from the tree, separated from the plant, but you compensate by protecting, recreating, generating additionality in a habitat"*.

7.2.3 Proposals

In summary, the proposals made to improve the implementation of the mitigation hierarchy in practice are:

- Enhancing the design phase of projects to integrate avoidance and minimization measures upfront.
- Make compensation measures deliberately costly and challenging to implement.
- Incorporate the analysis of project alternatives, particularly in terms of location, into the decision-making process by linking it to the costs of compensation measures.
- Strengthen the role of the Environmental Assessment Service in providing guidance and information on alternatives to compensation measures.
- Develop a typology of projects to categorise when compensation measures are appropriate and when they are not.
- Require developers to provide explicit statements on how they have applied the mitigation hierarchy during the assessment process.
- Adopt the ecosystem-based approach when determining measures to address biodiversity impacts.

7.3 Effective implementation of mitigation measures in practice

7.3.1 Effective implementation and accountability mechanisms

Two participants argued that there was a need to ensure the effective implementation of the measures as designed. In this regard, participant C expressed that *"there should be a preliminary analysis of the feasibility of the measures that you are going to develop"*, and participant M added that *"the basic thing is to ensure the effective implementation of the*

measure as it was designed, otherwise, there could be a logical incentive from the developers to make the measure as cheap as possible to implement".

Secondly, the fact that measures (as stated in the planning permission) needed to have accountability in terms of the biodiversity goals was raised. Participant C argued that: *"there should be a roadmap that gives you everything, where are you going to do it [implement the measures], what are you going to achieve, this is the maps, this is what I am going to monitor, the year, this is what I want to achieve, this is my control plot. But all in a traceable sheet, so you don't have to go to other documents to look for the data"*. Participant A added that: *"the developer should deliver the monitoring in a certain way, with clear rules, in a certain format, and also showing a traceability of what they are reporting, in order they can show the biodiversity gains"*.

7.3.2 Comprehensive design of the measures

The importance of the design of the measures was raised by a few participants. Participant C expressed that *"measures should be related to the size of the project"*. In terms of the size of the projects, participant A added that: *"sometimes the area of influence is poorly determined… is a much larger area than what the developers often propose, and that affects a component such as an ecosystem"*.

7.3.3 Proposals

Overall, the proposals to ensure effective implementation of the measures in practice are:

- Conduct preliminary feasibility analyses and establish mechanisms to ensure the effective implementation of measures as designed.
- Establish clear accountability mechanisms and standardised reporting for biodiversity measures.
- Ensure that the design of biodiversity measures is proportionate to the size and scale of the project, taking into account a more comprehensive area of influence.

7.4 Improving certainty of NNL

7.4.1 Adaptive management and continuous improvement

In order to achieve NNL, adaptative management was argued to be crucial by two participants. Participant M stated that *"there should be some mechanism that allows me to make adaptations, which is, I think, the most difficult, the most central part of the issue. Adaptive management is applicable to biodiversity issues and it exists for a reason, the whole scientific world says that you have to be permanently monitoring to see if the path you are following is working or not"*. Participant G1 also agreed*: "We must accept a level of uncertainty in what is being proposed and really allow efforts to be directed towards what is most effective… And if that means modifying the measure that was initially proposed, well, there should be this opportunity, but it doesn't exist"*.

In terms of continuous improvement, being able to know whether the measure is working or not to achieve NNL, participant M expressed that *"there should be a proper monitoring and assessment of the measure, and good feedback. Not only in terms of whether the measure was successful or not, but also the failure, because that will allow you to know why it did or did not work"*, and added: *"For the biodiversity issue, it is very difficult to ensure effective implementation if you don't have the knowledge of the measures that actually work"*. Participant C also agreed: *"If a measure is not sustainable over time, I can no longer propose that"*.

7.4.2 Strengthened compliance and precautionary principle

Two participants expressed that there should be major penalties for non-compliance with achieving the outcomes of the measures established in the planning permission. Participant G2 said that: *"The developer must actually have a consequence if the measure did not work"* and added: *"I have seen thousands of environmental impact studies that say we are going to monitor, monitoring by itself is nothing, monitoring needs to have a consequence"*, referring to the consequences for the permission granted to the developer. Participant N considered that: *"sanctions should be aimed at establishing penalties in the event that the information that should be provided is not provided"*.

Participant N also raised the fact that *"the incorporation of the precautionary principle, for example, which has already been incorporated through different laws, can also be a contribution"*, in terms of improving certainty of NNL.

7.4.3 Proposals

To summarise, the proposals to improve the certainty of NNL are:

- Integrate adaptive management into the implementation of biodiversity measures to ensure flexibility and responsiveness.
- Establish robust monitoring, assessment, and feedback mechanisms that not only track the success of measures but also learn from failures to support continuous improvement.
- Implement stricter penalties and consequences for non-compliance with the outcomes of biodiversity measures.
- Incorporate the precautionary principle more explicitly into the biodiversity assessment and mitigation process

7.5 Improving monitoring

7.5.1 Enhancing clarity and communication in monitoring

Some participants raised the fact that specific conditions of monitoring should be better established in the planning permission, in order to improve the monitoring actions in the practice post approval decision. Participant E stated that *"the monitoring to verify the zero net loss has to be very clear and established in the permission planning in order that the SMA* [Superintendency of the Environment] *can monitor"*. Participant M expressed that *"the measure has to be designed to make the monitoring as efficient as possible"*.

Additionally, it was discussed that the way that monitoring results are presented in the reports should be improved, in order to facilitate the monitoring of the measures. Participant A expressed that *"until very recently, monitoring did not contribute much, there was no way to follow up on it because the format in which monitoring was requested was often in PDF format, files that nobody checked… such a report cannot be usable and cannot be assessed against other instruments, the idea is to make this easier to monitor"* and participant N concerned about the information gap that is generated when monitoring is not well specified: *"perhaps the form, periodicity and obligation of the monitoring reports could be improved in an integrated system, because the system is based on reports from the developers, and often the information they submit is not reliable or complete"*.

7.5.2 Proposals

In brief, the proposals for improving monitoring are:

- Establish clear, specific monitoring conditions in the planning permission to ensure effective post-approval monitoring and enforcement.
- Improve the format, accessibility, and reliability of monitoring reports by implementing an integrated, standardised system.

7.6 Strengthen capacity

7.6.1 Institutional capacity building

This was one of the most individually discussed issues among the participants. In terms of skills development, it was widely agreed that training of the relevant authorities involved in the process (evaluators and agencies participating in the environmental impact assessment) should be improved. In this regard, participant G1 expressed that: "*There is always the problem that the agencies give their opinion on things that are not their responsibility or that they do not know… there should be a more qualified and more informed entity"* and added: *"the State has to have these instruments and clear and mainstreamed definitions for those who have a say in the matter"*. Participant G2 raised the concern about the functioning of the environmental impact assessment review process: *"the agencies are very bad, the people are poorly paid, they are unprofessional, they have little capacity, that is to say, they have little room to be able to check measures other than those they are used to check… They use laws that are very outdated, with very restricted capacities and very high pressures, so they have no incentive to accept other measures that are, for example, in the new national guide… agencies need to be trained and coordinated, a technical leap is needed for doing things better"*. Participant G1 considered that *"there has to be a coordination of the agencies. The job to align all this belongs to the Environmental Assessment Service, they have to align the agencies and give clear instructions"* and participant N also agreed: *"the solution is the Environmental Assessment Service, which issues the national guides, should create this training for the agencies"*.

Moreover, as the main responsibility for managing the information delivered by the developer of the project to the environmental assessment process is from the Environmental Assessment Service and the evaluators, the importance of training and assessing the evaluators was raised, in order to improve their competences. In this regard, participant G1 argued that *"the*

evaluators have to be well trained and have to be clear about what is acceptable as a measure and what is not, and it is very understandable that this is not happening today because they are overwhelmed, they do not necessarily have the specific knowledge to address the issues" and participant G2 also supports this opinion: *"I believe that the evaluator's capacity is low, and this low capacity has to do with the fact that he is a poorly paid evaluator in a Service with very few capacities, and it is much easier for him to approve what he has been approving"*. In this sense, participant N proposed that it may be advisable: *"perhaps to assess the evaluators, to generate some mechanism to know what the level of knowledge or interpretation they have, at least on the main issues, because there is a lot that needs legal interpretation on whether or not the requirement is fulfilled"*.

Some participants also discussed the fact that the last update of the national guides is recent, therefore more experience and practice using the national guides is needed to refine the knowledge, that is to say, 'learning by doing'. Participant A confirmed that *"it needs to be used* [the national guides] *and experience needs to be gained because the guide can still be improved"*. Participant E explained that: *"In fact, one issue that has been recurrent is the revision of the evaluation criteria"* and added: *"Once we make all this systematic, then we will be able to generate synergies between the agencies in order to be able to monitor biodiversity offsets in a way that crosses all the factors"*. Participant N considered that *"the first thing to encourage is to educate, to make it known, and not perhaps exclusively by the consultants, who of course have to know about it, but also by the citizens, who are the ones who will eventually participate in the processes of citizen participation… In this sense, I believe that education and knowledge and dissemination of the contents of this guide is the first priority"*.

7.6.2 Collaboration and consultant selection

In the EIA System in Chile, environmental consultants are contracted by the developer of the project to oversee, write, and design the environmental impact studies to be submitted to the assessment process. The fact that they are paid directly by the developers generated some questioning from some of the participants, who thought that it should be the State who select the consultants based on objective criteria. Participant G1 expressed that: *"The problem is that it is the project owners* [developers] *who pay the consultants and the incentive for both is that the project is approved as quickly as possible, and that it contains the fewest possible measures and identified impacts, and to reverse that logic is unrealistic. So, the basic problem is that consultancy firms do not have the right incentives to be able to really carry out an impact*

assessment, and this would finally be achieved by not having a direct relationship [with the developer]*, but by putting the studies out to tender"*. Participant G2 also supported this opinion: *"The problem is that the owners propose these studies* [developers]*, which are very twisted in the way they are proposed, the fact that the owner himself pays consultants to carry out the study, already has a lot of vices because obviously he is going to pay for a study that has identifies the least possible environmental impacts… the studies are done with a focus on finding the least possible environmental impacts, so they omit information, I don't know, they trick information, and with consultants, who are also super-trained to propose what is always approved and not to propose creative measures"*. Participant N agreed saying: *"Everyone knows that the consultants are independent of the developers, but they are contracted, and they are looking forward to the project being approved… So, the problem is precisely that, as the Environmental Impact Assessment System is designed to approve projects, not to reject them"*.

Additionally, participant E talked about the importance of encouraging collaborative work with the private sector and universities, and expressed that: *"there is a need to encourage more collaborative work between the private sector and universities to develop undergraduate and postgraduate theses, in order to scale up knowledge in terms of compensation and make it effective"* and added: *"before working on the studies, to meet with academics, to gather the experience of what compensation measures have worked, how they have worked, and how long monitoring is required"* expressing the need to generate technical consultancies from universities and research centres.

7.6.3 Proposals

- Develop and implement comprehensive training programs for relevant authorities involved in the EIA process to improve their skills, knowledge, and coordination.
- Implement training programs and regular assessments for evaluators to enhance their skills, knowledge, and ability to make informed decisions.
- Promote a continuous learning process through the practical application of the National Guides.
- Restructure the process by which environmental consultants are selected, so that the State or an independent body chooses the consultants based on objective criteria rather than allowing developers to directly hire them.

- Foster greater collaboration between the private sector, universities, and research centres to develop technical consultancies and expand knowledge on effective compensation measures.

7.7 Discussion

This chapter explored opportunities for improving biodiversity outcomes in Chile through the implementation of the mitigation hierarchy, and appropriate use of compensation measures in the environmental impact assessment process (the third objective of the thesis). As explained in Chapter 3, for pragmatic reasons data collection from the focus group was complemented with individual supplementary semi-structured interviews, as not all participants were able to attend the scheduled focus group. Although this mixed approach allowed for the inclusion of diverse perspectives (Creswell & Poth, 2018), the limitation of not having all participants engage in a collective discussion restricts the generalisability of the findings. Without a full group dynamic, some of the nuances that emerge through interaction in focus group settings (Morgan, 1996) may be missing, and thus the results reflect individual viewpoints rather than consensus or debate among all participants. Despite this limitation, the combination of methods enhanced the richness of the data (Tashakkori & Teddlie, 2010), intended to propose practical solutions to several issues identified in Chapter 6. The discussion that follows interprets these findings in relation to existing literature, reflect on their implications, and suggests opportunities for enhancing policy and practice, although caution is needed in extrapolating the findings to broader contexts.

7.7.1 Improve the implementation of the mitigation hierarchy in practice

The first finding relates to the need to better implement the mitigation hierarchy. The participants provide rich insights and recommendations into strategies aimed at facilitating the effective implementation of the mitigation hierarchy in practice. The first proposal arising from the views of some participants (E, G1, and G2) was to enhance the design phase of projects to integrate avoidance and minimization measures upfront. As designing projects with built-in mitigation measures ensures that only unavoidable impacts remain to be addressed (Hayes, 2014; Moilanen & Kotiaho, 2018), these participants argued the benefits of properly documenting the efforts of avoidance in the EIA study, even if they occurred prior to the assessment process (during the design stage), to provide the public and decision-makers with a more comprehensive understanding (Larsen et al., 2018). Failure to report these measures

represents a missed opportunity to evaluate whether efforts were made to follow the mitigation hierarchy. This aligns with existing literature (Brownlie et al., 2013; Clare et al., 2011; Ekstrom et al., 2015; Phalan et al., 2018), which stresses the importance of reinforcing avoidance and minimisation to prevent unnecessary biodiversity loss.

A second proposal extracted from the experience of participants A, G1, and G2 was to make compensation measures deliberately costly and challenging to implement. This aligns with the idea that financial pressure can drive better project design, forcing developers to explore more sustainable, less impactful options at the avoidance or minimisation stages (Moilanen & Kotiaho, 2018). By ensuring compensation is expensive and rigorously designed, developers would be more motivated to focus on effective mitigation and repair strategies upfront, thus reinforcing the hierarchy's initial steps.

Incorporate the analysis of project alternatives, particularly in terms of location, into the decision-making process by linking it to the costs of compensation measures was a third proposal coming from the point of view made by participants C and A, so the developer has an opportunity to explore less harmful options and consider a more sustainable project design (Brownlie et al., 2013; Phalan et al., 2018; Pilgrim et al., 2013). This approach would involve incentivising developers to consider alternative project locations where the environmental impacts—and consequently, the costs of compensation—would be lower.

Another proposal was made (considering the observations of participants M and C) to strengthen the role of the Environmental Assessment Service in providing guidance and information on alternatives to compensation measures. This would ensure that developers are informed about other viable options early in the project planning process, ultimately enhancing mitigation efforts (Phalan et al., 2018). This approach would not only lead to more effective mitigation but also promote greater environmental sustainability throughout the project lifecycle.

Moreover, the participant M discussed the proposal of developing a typology of projects to categorise when compensation measures are appropriate and when they are not. This approach is valuable because, first and foremost, it is crucial to clearly define what constitutes a compensation measure and ensure that it is correctly applied to the specific type of project or the component of biodiversity affected (Bigard et al., 2017; Pope et al., 2021). By establishing a clear framework, this typology would help ensure that compensation is only implemented in

situations where avoidance or minimisation measures are not feasible or sufficient (de Witt et al., 2019; Jacob et al., 2016; Martin et al., 2016; zu Ermgassen et al., 2020).

Furthermore, a proposal emerging from the observations of participants M, G1, and A was to require to developers to provide explicit statements on how they have applied the mitigation hierarchy during the assessment process. This would involve mandating developers to document and justify their decisions at each step of the hierarchy—explaining what avoidance and minimization measures were attempted, why repair measures may not be feasible, and why compensation measures are being proposed as a last resort (Kujala et al., 2022; Marshall et al., 2024).

A final proposal, based on the insights of participants E, G1, and G2, was to adopt an ecosystem-based approach when determining measures to address biodiversity impacts. This recommendation aligns with biodiversity offset best practice principle 12 (see Section 4.2.12), where the ecosystem-based approach is identified as a best practice for biodiversity offsetting. Although this approach is established in the National Guides (see Table 4.2), it has not yet been effectively implemented in practice, according to these participants. They emphasized that adopting this approach would require a paradigm shift—from focusing on individual species or isolated components of biodiversity to considering the broader ecosystem as an interconnected whole (Brownlie & Treweek, 2018; Maron et al., 2021b).

7.7.2 Ensure effective implementation of the measures in practice

Another finding that emerged was the challenge of ensuring effective implementation of mitigation measures in practice. The first proposal drawing from the perspectives of two participants (C and M) was to conduct preliminary feasibility analyses and establish mechanisms to ensure the effective implementation of measures as designed, ensuring a more realistic planning during the EIA process (Pilgrim et al., 2013; Quétier et al., 2014). This aligns with biodiversity offset best practice principle 9 (see Section 4.2.9, which is not entirely implemented in the Chilean policy (see Table 4.2). By requiring feasibility studies, this solution aims to enhance accountability and ensure that the mitigation hierarchy is applied rigorously, leading to better biodiversity outcomes.

A second proposal reflected in the feedback from two participants (A and C) was to establish clear accountability mechanisms and standardised reporting for biodiversity measures. This

recommendation highlights the need for transparency and consistency in how biodiversity impacts and mitigation efforts are documented and evaluated, aligning with biodiversity offset best practice principle 16 (see Section 4.2.16) (de Witt et al., 2019; Evans, 2023). Although it is established in the National Guides (see Table 4.2), the participants argued for a detailed and accessible plan outlining where measures will be implemented, their objectives, monitoring protocols, timelines, and control plots, all consolidated into a single, traceable document (Virah-Sawmy et al., 2014).

A third proposal derived from the inputs of two participants (A and C) was to ensure that the design of biodiversity measures is proportionate to the size and scale of the project, taking into account a more comprehensive area of influence (Evans, 2023; Fitzsimons et al., 2014), which is also biodiversity offset best practice principle 6 (see Section 4.2.6). This principle is established in the updated guide 2022-2023, which reflects recent advances in biodiversity practices, but it was absent in the 2014 guide, which explains why it has not yet been widely implemented in practice (See Table 4.2). By ensuring that the area of influence is correctly determined and reflected in the design of the measures, the project's full environmental impacts would be better addressed, resulting in more effective mitigation of biodiversity (Kiesecker et al., 2009).

7.7.3 Improving the certainty of NNL

Improving the certainty of achieving NNL of biodiversity was another finding that arose during the discussions with some participants, expressing that the current NNL framework lacks the precision and rigour needed to ensure that biodiversity losses are fully compensated. The first proposal informed by the views of two participants (M and G1) was to integrate adaptive management into the implementation of biodiversity measures to ensure flexibility and responsiveness (Chee, 2015; Souza et al., 2023). This was discussed as a principle in Section 4.2.13. This principle, included in the updated 2022-2023 was not fully addressed in the 2014 guide, potentially explaining why it has not yet been entirely integrated into current practices (Table 4.2). This solution would allow the adjustment of measures in response to findings, ensuring that efforts are continually directed toward the most effective strategies to achieve NNL of biodiversity (Mac Auliffe & Scagliotti, 2019).

Establish robust monitoring, assessment, and feedback mechanisms that not only track the success of measures but also learn from failures to support continuous improvement, was a

proposal that arose from the views of the participants M and C. This solution would ensure that biodiversity measures are continuously improved based on real-world data and experiences, enhancing their long-term effectiveness in achieving NNL of biodiversity (Quétier et al., 2014). This reflects the arguments made by Bezombes et al. (2019); Guillet and Semal (2018); Jacob et al. (2016); Quétier et al. (2014); zu Ermgassen et al. (2019), who highlighted considerable differences between the worldwide application of biodiversity offsets and the available evidence supporting their effectiveness in achieving NNL. As established in biodiversity offset best practice principle 13 (see Section 4.2.13) and discussed earlier, this concept is comprehensively addressed in the 2022–2023 guides (see Table 4.2). However, time will be required to observe the practical outcomes of its application, as the integration of such principles into real-world practices often involves a gradual process of adaptation and implementation.

A third proposal emerging from the observations of participants G2 and N was to implement stricter penalties and consequences for non-compliance with the outcomes of biodiversity measures, which is related to biodiversity offset best practice principle 15 (see Section 4.2.15). This would involve setting clear sanctions or penalties if the developer fails to meet the targets outlined in the planning permission. Although the legal and institutional frameworks in Chile include compliance with monitoring (see Table 4.2), the participants argued that monitoring alone is ineffective unless there are real penalties for failing to achieve the established biodiversity outcomes (de Witt et al., 2019; Niner et al., 2017). By ensuring that non-compliance has serious consequences, this solution would create a stronger incentive for developers to meet biodiversity goals and maintain long-term commitments to mitigation measures.

A final proposal coming from the views of participant M was to incorporate the precautionary principle more explicitly into the biodiversity assessment and mitigation process. A precautionary approach can help to ensure that biodiversity losses are not underestimated and that mitigation measures are designed with stricter safeguards to protect biodiversity, ensuring that uncertainties are accounted for upfront (Brownlie & Treweek, 2018; Chee, 2015; de Witt et al., 2019; Evans, 2023). Established as biodiversity offset best practice principle 11 in Section 4.2.11, it is not fully addressed in the National Guides (Table 4.2). By fully incorporating this principle, decision-makers would err on the side of caution, implementing

more robust mitigation measures and avoiding risky or potentially harmful projects until more information is gathered.

7.7.4 Improving monitoring

Effective monitoring allows for the assessment of whether mitigation measures are implemented as designed and whether they are achieving their biodiversity outcomes. Without robust monitoring frameworks, it is challenging to determine the success of biodiversity compensation and make necessary adjustments. In this regard, the first proposal based on the insights of participants E and M was to establish clear, specific monitoring conditions in the planning permission to ensure effective post-approval monitoring and enforcement (biodiversity offset best practice principle 15, see Section 4.2.15). This is consistent with findings from Bull et al. (2013); Gardner et al. (2013); Moilanen et al. (2024), who stress the need for rigorous monitoring frameworks with clear ecological indicators and long-term monitoring to accurately evaluate the effectiveness of biodiversity offsetting. By defining specific quantitative indicators, methodologies, and timelines for monitoring, and presenting them properly in the reports, monitor officers can effectively track the progress of biodiversity goals and assess the effectiveness of implemented measures.

A second proposal reflected in the feedback from participants A and N was to improve the format, accessibility, and reliability of monitoring reports by implementing an integrated, standardised system. Dias et al. (2017) supports the idea that monitoring is a critical component for assessing the success of biodiversity compensation, establishing a data collection protocol that incorporates a strong sampling design with consistent methodologies in the monitoring programmes. By creating an integrated system where monitoring data is consistently formatted, easily accessible, and standardized, stakeholders would be able to better track progress, identify issues early, and ensure that monitoring results contribute effectively to the achievement of NNL.

7.7.5 Strengthen capacity

Another finding of interest was the need to strengthen capacity among EIA practitioners and the relevant authority to effectively implement biodiversity compensation. A lack of technical expertise and resources was identified as critical barriers to successfully implement biodiversity compensation to achieve NNL. Following this, the first proposal from the point of

view of participants G1, G2 and N was to develop and implement comprehensive training programs for relevant authorities involved in the EIA process to improve their skills, knowledge, and coordination. By implementing targeted training programs, the capacity of the agencies could be significantly enhanced, helping them evaluate and enforce biodiversity measures more effectively (Gardner et al., 2013; Pilgrim et al., 2013). This would also support the adoption of updated practices and tools, improving the overall quality and efficiency of the environmental assessment process.

A second proposal derived from the inputs of some participants (G1, G2 and N) was to implement training programs and regular assessments for evaluators (of the Environmental Assessment Service), to enhance their skills, knowledge, and ability to make informed decisions. By providing specialised training and introducing assessments to measure the evaluators' understanding of the relevant legal and technical matters, their competence could be significantly improved, resulting in more thorough and informed evaluations of environmental measures (Jenner & Balmforth, 2015). This would help ensure that the environmental impact assessment process is more rigorous and effective in achieving biodiversity protection goals.

A third proposal drawing from the perspectives of some participants (A, E and N) was to promote a continuous learning process through the practical application of the National Guides. By encouraging both hands-on experience with the guides and wider educational efforts, stakeholders involved in environmental assessments can improve their understanding and effectiveness in applying the national guides (Bull et al., 2017b; Jenner & Balmforth, 2015). This approach will foster better coordination, synergies between agencies, and enhanced public participation, contributing to the more effective achievement of biodiversity goals.

The fourth proposal emerging from the observations of some participants (G1, G2 and N) was to restructure the process by which environmental consultants are selected, so that the State or an independent body chooses the consultants based on objective criteria rather than allowing developers to directly hire them. The employment of consultants by the developers could generate a bias due to pressure that clients apply to have a favourable environmental report prepared (Hollick, 1986). Under the current EIA system in Chile, developers directly hire consultants, creating a conflict of interest that might incentivises favourable reporting to secure repeat business or future contracts (Enríquez-de-Salamanca, 2018). Although there is a register of consultants in Chile intended to prevent biased reports, as it has been discussed in the

literature as a form of improve quality and minimise bias (Hollick, 1984), the restructuring suggested could improve the credibility and quality of EIA by ensuring that consultants are accountable to the public interest, fostering transparency and independence in environmental decision-making.

The final proposal highlighted by participant E was to foster greater collaboration between the private sector, universities, and research centres to develop technical consultancies and expand knowledge on effective compensation measures. This aligns with findings in the literature (Gardner et al., 2013; Gelcich et al., 2017; Wende et al., 2018) which suggest that investments in local capacity building, research, and environmental education are crucial for creating the conditions necessary for offsetting success. This approach would strengthen the capacity of both the private sector and the public authorities involved in environmental assessments, ultimately contributing to more effective biodiversity conservation and the achievement of NNL goals.

Chapter 8 Conclusion

In this concluding chapter, the findings of this research are synthesised to evaluate how the EIA system in Chile can help to achieve no net loss of biodiversity and contribute to reducing biodiversity loss in accordance with national legislation and international best practices. By examining both the policy framework and practical application of biodiversity offsets, the research highlights the strengths, gaps, and challenges of the current EIA system. Through a comprehensive analysis of Chile's alignment with global standards, the study also identifies key opportunities for improving the integration of biodiversity considerations into decision-making processes. The chapter concludes with recommendations aimed at enhancing the effectiveness of biodiversity protection efforts in Chile, thereby supporting the broader goal of achieving NNL of biodiversity.

8.1 Summary of main findings

The purpose of this research was to evaluate how the Environmental Impact Assessment System in Chile, along with other environmental decision-support tools, could effectively contribute to the reduction of biodiversity loss in accordance with current national environmental legislation, through the research question 'How can the EIA System in Chile help to achieve no net loss of biodiversity?'.

The first objective 'to evaluate Chilean policy in relation to international benchmarks', sought to compare Chile's policies to established international benchmarks, to identify gaps in the legislative frameworks and highlight areas where Chile could enhance its approach to biodiversity offsetting (Chapter 4). The literature review for this study identified 18 international best-practice principles for biodiversity offsets, forming a global analytical framework for evaluating and improving biodiversity offset policies (Norton, 2009; Salès et al., 2023a). This framework is versatile, aiming to support standardised, high-quality offset practices across regions while allowing adaptation to local contexts. The comparative analysis revealed substantial alignment between the 2014 guide and the National Guides, and the global best practices, especially following the updates in 2022-2023. Most principles, such as the mitigation hierarchy, additionality, equivalence, long-term outcomes, and compliance with monitoring, are well-integrated. However, certain principles—like the precautionary approach, adaptive management, equity and rights-based approaches—are not fully addressed. Furthermore, the principle related to cumulative, direct, and indirect impacts, and three

principles involving social considerations are absent from Chile's policy framework. Emphasis is placed on incorporating the principle of BNG beyond merely achieving NNL, aiming to ensure measurable improvements in biodiversity that extend beyond simply balancing impacts.

As indicated in Chapter 3, the intention was to revisit the analytical framework in light of the empirical findings, learnt from the interviews and focus group, to ensure that no critical elements had been overlooked in the international literature on biodiversity offset principles. One such gap that emerged by comparing this evidence with the principles established in Chapter 4, was the lack of detailed consideration for monitoring protocols. While the original framework included monitoring as part of principle 13 (Adaptive management and monitoring), it did not explicitly account for the operational challenges and inconsistencies raised during the interviews and focus group. For example, several participants (Interviewees C3, M1 and M2 in section 6.5.1 and 6.5.2) emphasised the absence of standardised monitoring protocols, inconsistent definitions of success criteria, and limited long-term follow-up of biodiversity outcomes. These insights revealed that the practical implementation of monitoring is often fragmented and poorly integrated, undermining the effectiveness of adaptive management. Based on this evidence, a new assessment criterion was added under Principle 13 to explicitly address the need for clear guidance on the planning, design, and long-term implementation of monitoring activities (Table 8.1). This refinement strengthens the analytical framework by grounding it more firmly in the realities of policy implementation.

Table 8.1 Analytical framework for evaluating policies related to biodiversity offsetting following standard criteria from the literature, including a new principle from this thesis

Principle	Assessment Criteria	References
1. Adherence to the mitigation hierarchy	a) First avoid impacts b) Minimise and reduce impacts as much as possible c) Biodiversity offsets as a last resort	BBOP (2018); Benabou (2014); Bergès et al. (2020); Brownlie and Treweek (2018); Brunetti et al. (2023); de Witt et al. (2019); Fitzsimons et al. (2014); Niner et al. (2017)
2. Biodiversity net gain (BNG)	a) Beyond NNL b) Measurable gains c) Net positive outcome	IUCN (2016); Brownlie and Treweek (2018); Bull and Brownlie (2017); CIEEM (2016); Fallding (2014); Quétier et al. (2014); (Salès et al., 2023b)
3. Limits to what can be offset	a) Incorporate limits to offsetting b) Identify irreplaceable or vulnerable biodiversity c) Define 'no-go' zones	BBOP (2018); IUCN (2016); CIEEM (2016); Chee (2015); de Witt et al. (2019); Maron et al. (2021a); Souza et al. (2023)

Table 8.1 Analytical framework for evaluating policies related to biodiversity offsetting following standard criteria from the literature, including a new principle from this thesis

Principle	Assessment Criteria	References
4. Additionality	a) Offsets must deliver additional benefits b) Exceed existing obligations or legal requirements c) Outcomes beyond the results expected without offset	de Witt et al. (2019); Evans (2023); Fitzsimons et al. (2014); Jacob et al. (2020); Niner et al. (2017); Quétier et al. (2014); Souza et al. (2023)
5. Equivalence/Like-for-like	a) Offsets must ensure ecological equivalence b) Like-for-like standard	IFC (2019); de Witt et al. (2019); Fallding (2014); Fitzsimons et al. (2014); Maron et al. (2021a)
6. Equivalence in size and scale	a) Proportionate in size and scale b) Correspond to the extent of biodiversity damage	Evans (2023); Fitzsimons et al. (2014)
7. Proximity	a) Proximity to the impact site b) Proper site selection	Bull et al. (2017a); Grimm and Köppel (2019)
8. Offsets from earliest stages	a) Early integration into planning b) Establish offsets before activities begin c) Addressing potential time lags	Brownlie and Treweek (2018); de Witt et al. (2019); Fallding (2014); Maron et al. (2021a); Quétier et al. (2014); Souza et al. (2023)
9. Offsets measures must be feasible	a) Feasibility of offset measures b) Project developers' responsibility	Quétier et al. (2014)
10. Long-term outcomes	a) Long-term strategic conservation goals b) Offset must endure for as long as the residual impacts c) Proportionality in duration	BBOP (2018); Fallding (2014); Fitzsimons et al. (2014); Quétier et al. (2014)
11. Precautionary approach	a) Precautionary principle b) Account for uncertainties and risks c) Anticipating and managing risks and uncertainties	Brownlie and Treweek (2018); Chee (2015); de Witt et al. (2019); Evans (2023); Fitzsimons et al. (2014); Simmonds et al. (2022)
12. Ecosystem approach	a) Integrate ecosystem strategies b) Net outcome for key biodiversity elements c) Ecological changes assessed at spatial and temporal scales	BBOP (2018); IFC (2019); IUCN (2016); Brownlie and Treweek (2018); de Witt et al. (2019); Maron et al. (2021a)
13. Adaptative management and monitoring	a) Performance-based ecological goals b) Monitoring and evaluation system c) Clear responsibilities and monitoring mechanisms d) Ensuring consistency in monitoring planning, design, and implementation	Brownlie and Treweek (2018); Chee (2015); Quétier et al. (2014); Souza et al. (2023)
14. Cumulative, direct, and indirect impacts	a) Assessing cumulative, direct and indirect impacts b) Broader effects on environment considerations	de Witt et al. (2019); IUCN (2016)
15. Compliance with monitoring and enforcement	a) Oversight and compliance b) Legal and institutional frameworks c) Enforceable and auditable	IUCN (2016); de Witt et al. (2019); Evans (2023); Fallding (2014); Niner et al. (2017)

Table 8.1 Analytical framework for evaluating policies related to biodiversity offsetting following standard criteria from the literature, including a new principle from this thesis

Principle	Assessment Criteria	References
16. Participatory and transparent approach	a) Stakeholder engagement b) Effective participation c) Transparency and communication	BBOP (2018); Brownlie and Treweek (2018); de Witt et al. (2019); Evans (2023); Fallding (2014)
17. Support evidence-based approaches	a) Rely on robust environmental information b) Integrating science with traditional knowledge	BBOP (2018); IUCN (2016); Brownlie and Treweek (2018); Fallding (2014)
18. Equity and rights-based approach	a) Equitable design and implementation of offsets b) Prioritise indigenous rights and local communities c) Free, Prior, and Informed Consent (FPIC)	BBOP (2018); IFC (2012); IUCN (2016); Fallding (2014)

Table 8.1 should therefore replace Table 4.1 as the analytical framework for researchers to use when evaluating the extent to which national policy is consistent with international best practice principles for biodiversity offsetting.

These challenges align with findings from the policy implementation literature, which emphasizes that strengthening biodiversity offset monitoring—through standardised methodologies, comprehensive impact assessments, and adaptive management—is essential for enhancing offset effectiveness and achieving no net loss (NNL) outcomes (Moilanen et al., 2024).

This revision to the analytical framework means that the analysis of the Chilean policy against the analytical framework is incomplete, as evaluation against the new assessment criteria to principle 13 from Table 8.1 is missing. Therefore, following the same scoring system used in Section 4.4,

Table ***8.2*** demonstrates that, even though the national policy fully complied with the new principle, it is not being achieved in practice, as was discussed by the interviewees.

Table 8.2 Performance of Chilean policy against new assessment criteria of principle 13

Principle	Chilean guide (2014)	Chilean guides (2022-2023)	Assessment Criteria	Observations
13. Adaptative management and monitoring	●	●	d) Ensuring consistency in monitoring planning, design, and implementation	d) Both the 2014 and 2022-2023 guides state that monitoring plan "must be clearly and accurately described, indicating the works or actions to be carried out; the description of the corresponding measure; its specific purposes; the form, timeframe, and place where it will be implemented, as well as indicators that allow accreditation of compliance with the measures" (SEA, 2022, p. 45).

Key: Level of adoption of the principles in the 2014 guide and 2022-2023 guides: ●, fully covered; ◗, partially covered; ○, absent. Principle also included in the BBOP principles. Principle not included in the BBOP principles.

The second objective, to evaluate Chilean practice in relation to national obligations seeks to analyse the practical implementation of compensation of biodiversity (offset) through the EIA System in Chile, specifically how it adheres to national environmental obligations concerning biodiversity. This analysis included quantitative data used for sample selection of projects submitted to the EIA System (Chapter 5), and qualitative data collected through interviews with EIA stakeholders (Chapter 6).

The quantitative analysis assessed the environmental Chilean legislation within its EIA system presented in Chapter 5, specifically evaluating its effectiveness in protecting biodiversity from the impacts of development projects, reviewing the available documents (EIS, authorisation documentation, and monitoring reports) from the case studies selected. One of the main findings was that although the regulatory framework in Chile incorporates the mitigation hierarchy, practical application often differs, favouring compensation over mitigation (avoidance and minimisation) and repair measures (Cares et al., 2023). Compensation has become the default approach, particularly in sectors like mining where avoidance and repair are impractical, and this further emphasises the importance of ensuring that offset policies are implemented appropriately given that compensation appears to more common than expected. However, future research is needed to verify whether other sectors might have greater potential to prioritize avoidance and minimisation. The predominance of compensation over mitigation and repair highlights a practical departure from the ideal mitigation hierarchy, suggesting logistical or financial factors may be influencing this trend (Martin et al., 2016). Additionally, some projects showed misclassification within the mitigation hierarchy although this was not

a major factor affecting biodiversity outcomes. Nevertheless, further refinement in categorising measures could improve adherence to the hierarchy (Jacob et al., 2016). Finally, monitoring and reporting biodiversity outcomes revealed further challenges. Often, claims of success in achieving NNL were based on satisfactory implementation of measures rather than measures of actual biodiversity outcomes, meaning quantitative assessments were rare, and project reporting tended to focus on selected biodiversity elements, providing a fragmented view of ecological impact (Moilanen et al., 2024).

To conclude, four key findings were derived from Chapter 5:

1. Better application of the 2014 guide is needed (as of the date of this chapter) in offsets.
2. Adherence to the mitigation hierarchy needs to be strengthened.
3. Practices need to be enhanced in order to consistently achieve NNL.
4. Monitoring systems need to be improved to achieve greater effectiveness.

From the thematic analysis of semi-structured interviews with stakeholders involved in the Chilean EIA process (qualitative analysis), presented in Chapter 6, several key findings emerged regarding the implementation of biodiversity compensation practices:

(i) The recent 2022-2023 guide update provides a better framework for standardising biodiversity compensation practices. Stakeholders, especially consultants and evaluators, acknowledged improvements in the 2022-2023 guide but noted that authorities inconsistently applied the National Guides, also highlighting a lack of expertise among evaluators from the Environmental Assessment Service, which sometimes led to varied interpretations and inconsistent implementation across regions —an issue that was also pointed out by ten Kate et al. (2004).

(ii) The mitigation hierarchy is not strictly implemented in practice. Interviews revealed that external factors—such as the costs, ease of implementing compensation, and previous project precedents—influence the design of measures. This deviates from the theoretical mitigation hierarchy, suggesting that biodiversity compensation is often used as an alternative rather than as a last resort (Hayes & Morrison-Saunders, 2007).

(iii) Despite Chilean guidelines aiming for NNL, participants expressed scepticism about achieving this in practice. Consultants raised concerns about the current metrics used to assess

biodiversity losses and gains, which often fail to fully capture biodiversity complexity and limit the feasibility of no net loss (Maron et al., 2012).

(iv) Effective monitoring is essential for evaluating biodiversity compensation, yet the study identified significant weaknesses in current practices. Monitoring was often inadequately conducted, lacking comprehensive strategies and quantitative indicators. This inconsistency leads to gaps in data, making it difficult to assess whether biodiversity compensation measures are meeting their goals (Bull et al., 2013; Moilanen et al., 2024).

In summary, critical findings regarding the implementation of biodiversity offsetting in Chile were highlighted:

1. Low adherence to the mitigation hierarchy, with established practices preventing the assessment of effectiveness and a lack of justification for applied measures.
2. Mitigation design is often cost-driven and limited expertise in some cases, restricting effectiveness, with systemic issues favouring compensatory approaches.
3. There is uncertainty around the achievement of NNL due to difficulties in verification and monitoring practices.
4. Monitoring reports prevent effective assessment of NNL and measurement of effectiveness.
5. Inconsistent guidance from authorities creates confusion and inefficiencies, highlighting capacity gaps in implementing biodiversity offsetting.

The third objective was to identify the opportunities for improving biodiversity outcomes in Chile, focusing on identifying practical pathways for enhancing the integration of biodiversity considerations within environmental decision-making processes, considering the issues informed by the preceding chapters. Chapter 7 synthesised the findings on how to improve biodiversity outcomes in Chile through better implementation of the mitigation hierarchy and more robust compensation measures in EIA. Key proposals include integrating avoidance measures in project design, making compensation measures deliberately challenging to encourage upfront mitigation, and adopting ecosystem-based approaches. Additionally, strengthening accountability, improving monitoring frameworks, and enhancing capacity through targeted training were all highlighted. These findings underscore the need for more transparent, enforceable, and adaptive approaches to achieve NNL of biodiversity effectively and sustainably.

In summary, while Chile's policy framework has made great strides in aligning with international biodiversity best practice offset principles, practical challenges persist. These findings emphasise the need for stronger enforcement of the mitigation hierarchy, better quantification of biodiversity and NNL, improved monitoring practices, and consistent application of the national guidelines to achieve reliable biodiversity outcomes.

8.2 Strengths and limitations of the research

This research offers a comprehensive evaluation of the EIA System in Chile in relation to biodiversity protection, drawing from both qualitative and quantitative data. One key strength of this study is its multi-method approach, combining a comparative policy analysis with in-depth stakeholder interviews and focus group (Bryman, 2016). This allows for a nuanced understanding of how biodiversity offsetting is applied in practice, providing valuable insights into the challenges and opportunities for improving environmental decision-making processes in Chile. The use of international best practice principles for biodiversity offsets also strengthens the research, offering a robust framework for evaluating Chilean policies.

However, the research also has certain limitations. One of the main constraints is the limited sample size of projects and stakeholders involved in the study (Boddy, 2016). While the selected case studies intended to offer an overview, the small sample size may not fully capture the diversity of practices across different sectors in Chile. Additionally, while qualitative data was gathered through interviews and focus groups (Creswell & Poth, 2018), the findings are based on the perspectives of a specific group of stakeholders and may not fully reflect the views of all actors involved in the EIA process, such as developers or local communities. Another limitation of this research was the relatively small attendance at the focus group, which meant that the sample of participants from this method was not as diverse or representative as initially hoped (Krueger, 1998; Morgan, 1997). This was exacerbated by last-minute withdrawals which reduced the ability of the focus group to generate multi-stakeholder discussions on potential solutions. This reduced the opportunity for gathering a wide range of perspectives within a single session, potentially limiting the depth of insights from different stakeholder groups. As a result, the findings from the focus group may not fully capture the broader spectrum of opinions or experiences related to biodiversity offsetting in the EIA System in Chile.

To mitigate this limitation, supplementary semi-structured interviews were conducted with other stakeholders unable to attend. While this helped to broaden the sample and provided

valuable individual insights (Tashakkori & Teddlie, 2010), the reliance on interviews also introduced the potential for bias, as each participant's responses were influenced by their specific roles and experiences. The qualitative nature of the interviews means that the findings reflect individual perspectives rather than a consensus, which could affect the generalisability of the conclusions. Future studies with a larger focus group and a more diverse set of participants could strengthen the representativeness of the data and help ensure a more comprehensive understanding of the challenges and opportunities in the practical implementation of biodiversity compensation in Chile.

A further limitation stems from the sequence in which the objectives were tackled. Objective 1 was undertaken last because of time pressures associated with the planning and ethical approval of interviews and focus groups (needed for objectives 2 and 3). This sequence does not influence the validity of the findings, but does mean that the best practice offset principles could not be used to frame the research focussing on practice based on compliance with principles. This remains an opportunity for a future researcher.

8.3 Contributions

This research makes several important contributions to both the academic field and practical policy application regarding biodiversity compensation in Chile. First, by evaluating the EIA System in Chile and comparing it against international best practices, the study provides a thorough analysis of the strengths and gaps in the country's policy and its practical implementation. This comparative framework is a valuable tool for researchers, policymakers and stakeholders in identifying areas where Chile can align more closely with global standards, thereby improving the effectiveness of biodiversity offsetting. Also, the framework offers a versatile tool for assessing any national system—whether already implemented or under development—regarding biodiversity offsetting practices. By using international best practice principles as a benchmark, this framework provides a structured approach for evaluating the alignment of national policies with global standards.

Second, the study contributes to the understanding of the real-world application of biodiversity offsets within the Chilean context. By combining quantitative analysis of EIA documents with qualitative interviews from key stakeholders, the research offers unique insights into the challenges of implementing the mitigation hierarchy and achieving NNL of biodiversity. This provides a basis for future policy improvements and interventions that are grounded in the

practical realities faced by project developers, environmental consultants, and regulatory bodies.

Additionally, the research contributes to the literature on environmental governance and biodiversity offsetting by proposing specific recommendations for enhancing the effectiveness of biodiversity measures. These recommendations, such as strengthening monitoring and accountability mechanisms, enhancing stakeholder training, and applying the precautionary principle more consistently, provide actionable pathways for improving the integration of biodiversity considerations in Chile's environmental decision-making processes. These insights will be valuable for future research, policy development, and the implementation of biodiversity protection measures both in Chile and in other regions facing similar challenges.

Finally, this thesis is currently contributing to the development of a new regulation in Chile regarding biodiversity compensation. The *Reglamento de Compensaciones de Biodiversidad* [Regulation of Biodiversity Compensation], drafted under the Article 38 of the Law Nº 21,600 (MINSEGPRES, 2023) (see Section 2.6), is currently been prepared by specialists in Chile, with publication expected in 2025. The researcher's expertise is informing the design of this regulatory framework, ensuring that the research findings presented here are directly integrated into policy-making. This contribution enhances the practical relevance of this PhD thesis in advancing biodiversity conservation efforts in Chile.

8.4 Reflections and recommendations

This research has highlighted both the progress and challenges of implementing biodiversity offsetting practices within Chile's EIA System. While the policy framework aligns broadly with international best practices, significant gaps remain in both the legislative framework and its practical application. The incorporation of the mitigation hierarchy, which is a fundamental principle in biodiversity offsetting, shows promise in theory but often deviates in practice, with compensation measures frequently becoming the default approach. This is particularly true in sectors like mining, where avoidance and minimisation strategies are often impractical. The study also found that the lack of effective monitoring, inconsistent application of the National Guides, and limited expertise among key stakeholders, contribute to difficulties in ensuring that biodiversity goals are met.

Another critical finding is that the concept of achieving NNL of biodiversity remains elusive in practice, with concerns about the practicality of assessing NNL of biodiversity accurately. Furthermore, the research uncovered weaknesses in the monitoring process, which often lacks the necessary quantitative indicators and comprehensive strategies to assess biodiversity outcomes effectively. These shortcomings are compounded by external factors such as financial constraints and ease of implementation, which influence the decision-making process in ways that sometimes overlook the core principles of biodiversity offsets.

To finalise, the recommendations derived from the thesis, the key proposals translating theory into practice might include:

- Enhance design phase: Focus on avoidance and minimisation measures early.
- Increase cost of compensation: Make compensation deliberately costly and difficult.
- Analyse project alternatives: Evaluate location options while linking decisions to compensation costs.
- Information of compensation measures: Environmental Assessment Service providing guidance.
- Develop typology: Categorise when compensation measures are appropriate.
- Mitigation hierarchy transparency: Require explicit reporting on hierarchy application.
- Ecosystem-based approach: Shift focus to interconnected ecosystems, not individual species.
- Feasibility mechanisms: Conduct feasibility analyses and ensure implementation mechanisms.
- Accountability and reporting: Create clear accountability and standardised reporting systems.
- Proportionate design: Align biodiversity measures with project size and scale.
- Adaptive management and monitoring: Establish robust systems to track success and learn from failures.
- Stricter penalties: Enforce consequences for non-compliance with biodiversity measures.
- Precautionary principle: Apply the precautionary principle in the assessment process.
- Integrated monitoring and reporting: Establish clear, specific monitoring conditions in planning permissions, supported by an integrated, standardised system to improve the

accessibility, format, and reliability of post-approval monitoring reports, ensuring effective enforcement.

- Training programs: Develop and implement training for authorities and evaluators to improve skills, knowledge, and coordination.
- Consultant selection: Restructure consultant selection based on objective criteria rather than developer preference.
- Collaboration: Encourage collaboration between the private sector, universities, and research centres to improve compensation measures.

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Appendixes

Appendix 1. List of paper Best Practice Principles

Author/Principles*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Benabou (2014)	x			x	x													
Berges et al. (2020)	x																	
Brownlie & Treweek (2018)	x							x			x	x	x			x	x	
Brunetti et al. (2023)	x				x													
Bull et al. (2017a)				x			x											
Bull and Brownlie (2017)		x																
Bull and Strange (2018)																		
BBOP (2018)	x		x	x						x		x				x	x	x
Chee (2015)	x		x								x				x			
CIEEM (2016)	x	x	x	x						x	x					x		x
de Witt et al. (2019)	x	x	x	x	x			x		x	x	x		x	x	x		
Evans (2023)				x		x					x				x	x		
Fallding (2024)	x				x		x	x		x	x				x	x	x	x
Fitzsimons et al. (2014)	x			x		x				x	x			x		x	x	
Grimm and Köppel (2019)					x		x			x	x	x	x		x	x		
IFC (2019)				x	x							x						
IUCN (2016)			x	x				x			x	x		x	x		x	x
Jacob et al. (2020)			x	x	x					x						x		
Maron et al. (2021)			x		x					x		x						
Niner et al. (2017)				x	x					x					x			
Quétier et al. (2014)				x			x	x	x	x			x					
Salès et al. (2023a)				x	x													
Salès et al. (2023b)				x	x													x
Simmonds et al. (2022)		x									x							
Souza et al. (2023)			x	x	x			x		x	x	x	x			x		
WBG (2016)				x	x					x								

*Numbers represent the principles as were numbered in Section 4.3

1. Adherence to the mitigation hierarchy
2. Biodiversity Net Gain (BNG)
3. Limits to what can be offset
4. Additionality
5. Equivalence/Like-for-like
6. Equivalence in size and scale
7. Proximity
8. Offsets from earliest stages
9. Offsets measures must be feasible
10. Long-term outcomes
11. Precautionary approach
12. Ecosystem approach
13. Adaptive management and monitoring
14. Cumulative, direct and indirect impacts
15. Compliance with monitoring and enforcement
16. Participatory and transparent approach
17. Support evidence-based approaches
18. Equity and rights-based approach

Appendix 2. Invitation letter interviews

Invitation letter interviews (English)

Invitation to participate in the research project titled:

"Integrating Biodiversity Offsets in the planning of EIA in Chile"

Dear (stakeholder),

I am conducting interviews as part of my PhD research study to increase the understanding of how Biodiversity Offset is being integrating in the planning of EIA in Chile, to evaluate the extent to which biodiversity is being protected from impacts of development projects by the Chilean environmental legislation. As a stakeholder involved in the process, you are in an ideal position to give me valuable first hand information from your own perspective.

The interview takes around 30 minutes and one hour and is informal. I will be trying to capture your knowledge and perspectives on how is being conducted EIA in terms of biodiversity concerns. Your responses to the questions will be kept confidential. Each interview will be assigned a number code to ensure that interviewees remain anonymous during the analysis and write up of findings.

There is no compensation for participating in this study. However, your participation will be a valuable addition to my research and findings could lead to improve biodiversity protection in the EIA process in Chile and that recommendations could have wider relevance to other jurisdictions as well.

If you are willing to participate, I could do the interview online from October 2023, so please suggest a day and time that suits you. If you have any questions, please do not hesitate to ask.

Thanks,

Rocío Cares,

Invitation letter interviews (Spanish)

Invitación a participar en el proyecto de investigación titulado:

“Integrando las Compensaciones de Biodiversidad en la planificación de EIA en Chile”

Estimado (participante),

Mi nombre es Rocío Cares, soy Bióloga Ambiental y Magíster en Ciencias de la Universidad de Chile, y actualmente me encuentro realizando un Doctorado en Ciencias Ambientales en la University of East Anglia, Norwich, Reino Unido.

Como parte de mi estudio de investigación de doctorado, estoy realizando entrevistas a expertos para aumentar la comprensión de cómo se está integrando la Compensación de Biodiversidad en la planificación de la Evaluación de Impacto Ambiental en Chile, para evaluar en qué medida la legislación ambiental chilena está protegiendo la biodiversidad de los impactos de los proyectos de desarrollo. Como parte involucrada en el proceso, usted está en una posición ideal para brindarme información valiosa de primera mano desde su propia perspectiva.

La entrevista dura alrededor de 30 minutos y una hora y es informal. Mi idea es capturar sus conocimientos y perspectivas sobre cómo se lleva a cabo la Evaluación de Impacto Ambiental en términos de preocupaciones sobre la biodiversidad. Sus respuestas a las preguntas se mantendrán confidenciales. A cada entrevista se le asignará un código numérico para garantizar que los entrevistados permanezcan en el anonimato durante el análisis y la redacción de los hallazgos.

No hay compensación por participar en este estudio. Sin embargo, su participación será una valiosa adición a mi investigación y los hallazgos podrían conducir a mejorar la protección de la biodiversidad en el proceso de EIA en Chile y las recomendaciones podrían tener una relevancia más amplia para otras jurisdicciones también.

Si está dispuesto a participar, yo podría realizar la entrevista online a partir de octubre de 2023, en el día y la hora que más le convengan. Si tiene alguna pregunta, por favor no dude en escribirme.

De antemano muchas gracias,

Rocío Cares.

Appendix 3. Interviews participant information sheet

Interviews participant information sheet (English)

PhD Thesis in Environmental Sciences: "Integrating Biodiversity Offsets in the planning of EIA in Chile"

PARTICIPANT INFORMATION SHEET

1. What is this study about?

You are invited to take part in the PhD thesis research titled "Integrating Biodiversity Offsets in the planning of EIA in Chile". The purpose of this research is to evaluate whether the EIA (Environmental Impact Assessment) System in Chile, along with other environmental decision-support tools, is achieving a reduction in biodiversity loss, according to the current environmental national legislation. As part of this research, EIA Chilean practice will be investigated and evaluated, considering the experience, knowledge and perspectives from the stakeholders involved in the EIA process. This Participant Information Sheet tells you about the research project. Knowing what is involved will help you decide if you want to take part in the study. Please read this sheet carefully and ask questions about anything that you don't understand or want to know more about.

Participation in this research study is voluntary.

2. Who is running the study?

The study is being carried out by PhD student Rocío Cares, School of Environmental Sciences, University of East Anglia.

PhD student Rocío Cares is supervised by:

Associate Professor Alan Bond, School of Environmental Sciences, University of East Anglia

Associate Professor Aldina Franco, School of Environmental Sciences, University of East Anglia

3. What will the study involve for me?

Your participation will involve completion of a consent form, and an interview that will be conducted in person by Rocío Cares, or online for the same person in case you are not able to do it in person. The interview will be semi-structured including closed and open questions. The closed questions are designed to address the problem of to what extent the outcomes for appropriate compensation of biodiversity are being achieved in EIA (Environmental Impact Assessment) practice in Chile. The open questions are designed to understand deeper the answer to the closed questions and to understand what leads to biodiversity outcomes. Audio recording will be used to transcribe the answers in order to analyse them through coding. Your responses will be downloaded to a password protected One Drive folder hosted through UEA (University of East Anglia) and deleted from any other storage place within 24 hours of collection or receipt. Your email response containing the completed consent will be deleted

and removed from the trash folder as soon as the attachments have been saved to this folder. The information provided will only be used for this PhD thesis and for future journal articles reporting the main results, as well as presentations at an International Conference. Your name and affiliation will remain anonymous.

4. How much of my time will it take?

The interview is expected to be 30 minutes to one hour long. Other than the interview, no additional time commitment is required.

5. Do I have to be in the study? Can I withdraw from the study once I've started?

Being in this study is completely voluntary and you do not have to take part. Your decision whether to participate will not affect your current or future relationship with the researchers or anyone else at the University of East Anglia.

If you decide to take part in the study and then change your mind later, you are free to withdraw at any time up to March 31st, 2024. You can do this by emailing Rocío Cares at R.Cares-Suarez@uea.ac.uk.

6. Are there any risks or costs associated with being in the study?

Aside from giving up your time, we do not expect that there will be any risks or costs associated with taking part in this study.

7. Are there any benefits associated with being in the study?

As the participation will be anonymous, there will not be any benefits associated other than being acknowledged in the thesis, journal articles and conference presentations as an anonymous interviewed.

8. What will happen to information about me that is collected during the study?

Completed forms returned by email will be downloaded into a password protected OneDrive folder hosted through UEA. The email used to send the completed forms will be deleted and removed from trash as soon as the data are downloaded to the password protected folder. Your responses to the questions will be kept confidential. Each interview will be assigned a number code to help ensure that personal identifiers are not revealed during the analysis and write up of findings.

By providing your consent, you are agreeing to us collecting personal information about you for the purposes of this research study. Your information will only be used for the purposes outlined in this Participant Information Statement, unless you consent otherwise. Data management will follow the UK General Data Protection Regulation Act 2020 (https://www.legislation.gov.uk/ukpga/2018/12/contents/enacted) and the University of East Anglia Research Data Management Policy 2022 (https://my.uea.ac.uk/documents/20142/9487190/FINAL+Research_Data_Management_Policy_v2-0+02+11+22.pdf/9dec535e-6af2-9aa6-c417-d4cc9481fbd3?t=1667577765003).

Your information will be stored securely, and your identity/information will only be disclosed with your permission, except as required by law. You will remain anonymous, and although every effort will be made to protect your identity, there is a risk that you might be identifiable due to the nature of any examples you provide. The expectation is that you do not provide such information as you will be anonymous.

9. What if I would like further information about the study?

When you have read this information, Rocío Cares will be available to discuss it with you further and answer any questions you may have. If you would like to know more at any stage

during the study, please feel free to contact Rocío Cares, PhD student, University of East Anglia, R.Cares-Suarez@uea.ac.uk, +44 07950650444.

10. Will I be told the results of the study?

You have a right to receive feedback about the overall results of this study. You can tell us that you wish to receive feedback by being sent an electronic copy of the journal article, if published, subject to your ticking the relevant box on the consent form. You would receive this electronic copy after publication in the journal.

11. What if I have a complaint or any concerns about the study?

The ethical aspects of this study have been approved under the regulations of the University of East Anglia's Science Faculty Research Ethics Committee.

If there is a problem, please let me know. You can contact me via the University at the following address:

Rocío Cares

School of Environmental Sciences

University of East Anglia

NORWICH NR4 7TJ UK

R.Cares-Suarez@uea.ac.uk

If you are concerned about the way this study is being conducted or you wish to make a complaint to someone independent from the study, please contact the Head of the School of Environmental Sciences, Professor Ian Renfrew (i.renfrew@uea.ac.uk), or the Ethics Officer for the School of Environmental Sciences, Dr Helen Pallett (H.Pallett@uea.ac.uk).

12. OK, I want to take part – what do I do next?

You need to fill in the consent form and return it by email, to R.Cares-Suarez@uea.ac.uk. Please keep the information sheet.

This information sheet is for you to keep

Interviews participant information sheet (Spanish)

PhD Thesis in Environmental Sciences: "Integrating Biodiversity Offsets in the planning of EIA in Chile"

HOJA DE INFORMACIÓN AL PARTICIPANTE

1. ¿De qué se trata este estudio?

Usted está invitado a participar en la investigación de tesis de doctorado titulada "Integración de Compensación de Biodiversidad en la planificación de EIA en Chile". El propósito de esta investigación es evaluar si el Sistema de Evaluación de Impacto Ambiental (SEIA) en Chile, junto con otras herramientas de apoyo a las decisiones ambientales, está logrando una reducción de la pérdida de biodiversidad, de acuerdo con la legislación ambiental nacional vigente. Como parte de esta tesis, se investigará y evaluará la práctica chilena de EIA (Evaluación de Impacto Ambiental), considerando la experiencia, el conocimiento y las perspectivas de los actores involucrados en el proceso de EIA. Esta hoja de información para el participante le informa sobre el proyecto de investigación. Saber lo que implica le ayudará a decidir si desea participar en el estudio. Lea este documento detenidamente y haga preguntas sobre cualquier cosa que no comprenda o sobre la que desee saber más.

La participación en este estudio de investigación es voluntaria.

2. ¿Quién dirige el estudio?

El estudio está siendo llevado a cabo por la estudiante de doctorado Rocío Cares, Facultad de Ciencias Ambientales de la Universidad de East Anglia (Inglaterra).

Rocío Cares está supervisada por:

Profesor asociado Dr. Alan Bond, Facultad de Ciencias Ambientales, Universidad de East Anglia

Profesora asociada Dra. Aldina Franco, Facultad de Ciencias Ambientales, Universidad de East Anglia

3. ¿Qué implicará el estudio para mí?

Su participación implicará completar un formulario de consentimiento y participar de una entrevista que será realizada presencialmente por Rocío Cares, u online por la misma persona en caso de que no pueda hacerlo presencialmente. La entrevista será semiestructurada incluyendo preguntas cerradas y abiertas. Las preguntas cerradas están diseñadas para abordar el problema de en qué medida se están logrando resultados para una compensación adecuada de la biodiversidad en la práctica de EIA en Chile. Las preguntas abiertas están diseñadas para comprender más profundamente la respuesta a las preguntas cerradas y comprender qué conduce a los resultados en materia de biodiversidad. Se utilizará grabación de audio para transcribir las respuestas con el fin de analizarlas mediante codificación, o Teams para la transcripción en caso de ser online. Sus respuestas se descargarán a una carpeta One Drive protegida con contraseña cuyo servidor es UEA (Universidad de East Anglia) y se eliminarán

de cualquier otro lugar de almacenamiento dentro de las 24 horas posteriores a su recolección o recepción. Su respuesta por correo electrónico que contiene el formulario de consentimiento se eliminará y será removido de la carpeta de papelera tan pronto como los archivos adjuntos se hayan guardado en esta carpeta One Drive. La información proporcionada únicamente será utilizada para esta tesis doctoral y para futuros artículos de revistas que informen los principales resultados, así como para una presentación en una Conferencia Internacional. Su nombre y afiliación permanecerán anónimos.

4. ¿Cuánto tiempo me llevará?

Se espera que la entrevista dure entre 30 minutos y una hora. Aparte de la entrevista, no se requiere ningún compromiso de tiempo adicional.

5. ¿Tengo que estar en el estudio? ¿Puedo retirarme del estudio una vez que haya comenzado?

Participar en este estudio es completamente voluntario y no es necesario que participe. Su decisión de participar no afectará su relación actual o futura con los investigadores ni con ninguna otra persona de la Universidad de East Anglia.

Si decide participar en el estudio y luego cambia de opinión, puede retirarse en cualquier momento hasta el 31 de marzo de 2024. Puede hacerlo enviando un correo electrónico a Rocío Cares a R.Cares-Suarez@uea.ac.uk.

6. ¿Existen riesgos o costos asociados con la participación en el estudio?

Aparte de dedicar su tiempo, no esperamos que existan riesgos o costos asociados con la participación en este estudio.

7. ¿Hay algún beneficio asociado con participar en el estudio?

Como la participación será anónima, no habrá ningún beneficio asociado más que ser reconocido en la tesis, artículos de revistas y presentaciones de congresos como entrevistado anónimo.

8. ¿Qué pasará con la información sobre mí que se recopile durante el estudio?

Los formularios completos que se devuelvan por correo electrónico se descargarán en una carpeta de OneDrive protegida con contraseña cuyo servidor es UEA. El correo electrónico utilizado para enviar los formularios completos se eliminará y será removido de la papelera tan pronto como los datos se descarguen a la carpeta protegida con contraseña. Sus respuestas a las preguntas se mantendrán confidenciales. A cada entrevista se le asignará un código numérico para ayudar a garantizar que los identificadores personales no se revelen durante el análisis y la redacción de los hallazgos.

Al brindar su consentimiento, acepta que recopilemos información personal sobre usted para los fines de este estudio de investigación. Su información solo se utilizará para los fines descritos en esta Hoja de información al participante, a menos que usted consienta lo contrario. La gestión de datos seguirá la Ley de Regulación General de Protección de Datos del Reino Unido de 2020 (https://www.legislation.gov.uk/ukpga/2018/12/contents/enacted) y la Política de Gestión de Datos de Investigación de la Universidad de East Anglia de 2022 (https:///my.uea.ac.uk/documents/20142/9487190/FINAL+Research_Data_Management_Policy_v2-0+02+11+22.pdf/9dec535e-6af2-9aa6-c417-d4cc9481fbd3?t=1667577765003).

Su información se almacenará de forma segura y su identidad/información solo se divulgará con su permiso, salvo que lo exija la ley. Usted permanecerá anónimo y, aunque se harán todos los esfuerzos posibles para proteger su identidad, existe el riesgo de que pueda ser identificable

debido a la naturaleza de los ejemplos que proporcione. La expectativa es que usted no proporcione dicha información (ejemplos) ya que será anónimo.

9. ¿Qué pasa si quisiera obtener más información sobre el estudio?

Cuando haya leído esta información, Rocío Cares estará disponible para discutirla más con usted y responder a cualquier pregunta que pueda tener. Si desea obtener más información en cualquier etapa del estudio, no dude en ponerse en contacto con Rocío Cares, estudiante de doctorado, Universidad de East Anglia, R.Cares-Suarez@uea.ac.uk, +44 07950650444.

10. ¿Me informarán los resultados del estudio?

Usted tiene derecho a recibir comentarios sobre los resultados generales de este estudio. Puede indicarnos que desea recibir una copia electrónica del artículo de la revista, si se publica, sujeto a que marque la casilla correspondiente en el formulario de consentimiento. Recibirá esta copia electrónica después de su publicación en la revista.

11. ¿Qué pasa si tengo una queja o alguna inquietud sobre el estudio?

Los aspectos éticos de este estudio han sido aprobados según las regulaciones del Comité de Ética en Investigación de la Facultad de Ciencias de la Universidad de East Anglia.

Si hay algún problema, hágamelo saber. Puede contactarse conmigo a través de la Universidad en la siguiente dirección:

Rocío Cares

Facultad de Ciencias Ambientales

Universidad de East Anglia

NORWICH NR4 7TJ REINO UNIDO

R.Cares-Suarez@uea.ac.uk

Si le preocupa la forma en que se está realizando este estudio o desea presentar una queja a alguien independiente del estudio, comuníquese con el director de la Facultad de Ciencias Ambientales, el profesor Ian Renfrew (i.renfrew@uea.ac.uk), o la Oficial de Ética de la Facultad de Ciencias Ambientales, Dra. Helen Pallett (H.Pallett@uea.ac.uk).

12. Está bien, quiero participar. ¿Qué hago a continuación?

Debe completar el formulario de consentimiento y enviarlo por correo electrónico a R.Cares-Suarez@uea.ac.uk. Por favor conserve esta hoja de información.

Esta hoja de información es para que usted la conserve

Appendix 4. Interviews Consent Form

Interviews Consent Form (English)

CONSENT FORM

Title of Project: "Integrating Biodiversity Offsets in the planning of EIA in Chile"

Name of Researcher(s): Rocío Cares (PhD student)

Please tick box

1. I confirm that I have read and understood the Information Sheet provided to me for the above study/project, I have had the opportunity to ask questions and I am happy with the answers. ☐
2. I understand the purpose of the study, what I will be asked to do, and any risks/benefits involved. ☐
3. I understand that my participation is voluntary and that I am free to withdraw at any time up until March 31st, 2024, without giving a reason. ☐
4. I understand that personal information about me that is collected over the course of this project will be stored securely and will only be used for purposes that I have agreed to. I understand that information about me will only be told to others with my permission, except as required by law. ☐
5. I understand that any quotes used in this study will be anonymised. ☐
6. I agree to take part in this study. ☐
7. I would like to receive an electronic copy of the article based on the data collected through this project, if published. ☐

_____	_____	_____
Name of Participant	Date	Signature

Interviews Consent Form (Spanish)

University of East Anglia

FORMULARIO DE CONSENTIMIENTO

Título del Proyecto: "Integración de Compensación de Biodiversidad en la planificación de EIA en Chile"

Nombre de la investigadora: Rocío Cares (estudiante de PhD)

Por favor marque la casilla

1. Confirmo que he leído y comprendido la Hoja de Información al Participante que se me proporcionó para el estudio/proyecto mencionado arriba, he tenido la oportunidad de hacer preguntas y estoy satisfecho con las respuestas. ☐
2. Entiendo el propósito del estudio, lo que se me pedirá que haga y los riesgos/beneficios involucrados. ☐
3. Entiendo que mi participación es voluntaria y que soy libre de retirarme en cualquier momento hasta el 31 de marzo de 2024, sin dar motivo. ☐
4. Entiendo que la información personal sobre mí que se recopile durante el transcurso de este proyecto se almacenará de forma segura y sólo se utilizará para los fines que he aceptado. Entiendo que mi información sólo se compartirá con otras personas con mi permiso, salvo que lo exija la ley. ☐
5. Entiendo que cualquier cita utilizada en este estudio será anónima. ☐
6. Acepto participar en este estudio. ☐
7. Me gustaría recibir una copia electrónica del artículo basado en los datos recopilados a través de este proyecto, si se publica. ☐

_____	_____	_____
Nombre del participante	Fecha	Firma

Appendix 5. Invitation letter Focus group

Invitation letter Focus group (English)

Invitation to participate in the research project titled:

"Integrating Biodiversity Offsets in the planning of EIA in Chile"

Dear (stakeholder),

I would like to invite you to take part in a focus group (small discussion group) on the 20th of March of 2024, at 10.00 am (CLT), in Santiago, Chile, about the integration of biodiversity compensation in the EIA system in Chile. The focus group should last no longer than one and a half hours.

The focus group will provide an opportunity for you to find out about the current state of the biodiversity compensation in Chile, and also to identify opportunities to improve the biodiversity outcomes. In particular, I would like to discuss how the development projects have incorporated the concepts of the Guide of Biodiversity Compensation and what are the challenges and what still needs to be done, from the perspective of people involved in biodiversity compensation throughout the entire EIA process.

The data will be collected through audio and tape recording, note-taking and participant observation. Your participation will be kept confidential and anonymous during the analysis and write-up of findings. More background information will be sent through e-mail to those confirming attendance before the focus group.

There is no compensation for participating in this study. However, your participation will be a valuable addition to my research and findings could lead to improve biodiversity protection in the EIA process in Chile and that recommendations could have wider relevance to other jurisdictions as well.

If you would like to take part in the focus group, please let me know by e-mailing R.Cares-Suarez@uea.ac.uk. If you have any questions, please do not hesitate to ask.

Thanks,

Rocío Cares,

Invitation letter Focus group (Spanish)

Invitación a participar en el proyecto de investigación titulado:

"Integrando las Compensaciones de Biodiversidad en la planificación de EIA en Chile"

Estimado (participante),

Como parte de mi estudio de investigación de doctorado, estoy organizando un focus group (pequeño grupo focal de discusión) a realizarse el 20 de marzo de 2024 a las 10.00 am en Santiago, para conversar sobre cómo se ha integrado la compensación de la biodiversidad en el marco del SEIA en Chile. Este focus group podría tener una duración de un par de horas, incluyendo un tiempo de break y catering.

Este focus group brindará la oportunidad de conocer el estado actual de la compensación de biodiversidad en Chile, de conversar y compartir ideas con otros actores involucrados en el proceso de evaluación en el SEIA y también de identificar oportunidades para mejorar los resultados que se buscan obtener a través de la compensación de biodiversidad. En particular, me gustaría discutir cómo los proyectos de inversión han incorporado los conceptos de la Guía para la Compensación de la Biodiversidad en el SEIA y cuáles son los desafíos y lo que aún queda por hacer, desde la perspectiva de las personas involucradas en la compensación de la biodiversidad a lo largo de todo el proceso de EIA.

Los datos se recopilarán mediante grabaciones de audio y video, toma de notas y observación del participante. Sin embargo, su participación se mantendrá confidencial y anónima durante el análisis y redacción de los resultados. Se enviará más información general por correo electrónico a quienes confirmen su asistencia, previo a la realización del focus group.

No hay compensación por participar en este estudio. Sin embargo, su participación será una valiosa adición a mi investigación y los hallazgos podrían conducir a mejorar la protección de la biodiversidad en el proceso de EIA en Chile y las recomendaciones podrían tener una relevancia más amplia para otras jurisdicciones también.

Si desea participar en este focus group, puede enviarme un correo electrónico a R.Cares-Suarez@uea.ac.uk o responder este correo. De antemano le agradezco su buena disposición y tiempo. Si tiene alguna pregunta, por favor no dude en escribirme.

Muchas gracias,

Rocío Cares.

Appendix 6 Focus group participant information sheet

Focus group participant information sheet (English)

PhD Thesis in Environmental Sciences: "Integrating Biodiversity Offsets in the planning of EIA in Chile"

PARTICIPANT INFORMATION SHEET

13. What is this study about?

You are invited to take part in the PhD thesis research titled "Integrating Biodiversity Offsets in the planning of EIA in Chile". The purpose of this research is to evaluate whether the EIA (Environmental Impact Assessment) System in Chile, along with other environmental decision-support tools, is achieving a reduction in biodiversity loss, according to the current environmental national legislation. As part of this research, EIA Chilean practice will be investigated and evaluated, considering the experience, knowledge and perspectives from the stakeholders involved in the EIA process. This Participant Information Sheet tells you about the research project. Knowing what is involved will help you decide if you want to take part in the study. Please read this sheet carefully and ask questions about anything that you don't understand or want to know more about.

Participation in this research study is voluntary.

14. Who is running the study?

The study is being carried out by PhD student Rocío Cares, School of Environmental Sciences, University of East Anglia.

PhD student Rocío Cares is supervised by:

Associate Professor Alan Bond, School of Environmental Sciences, University of East Anglia

Associate Professor Aldina Franco, School of Environmental Sciences, University of East Anglia

15. What will the study involve for me?

Your participation will involve completion of a consent form, and a focus group (small discussion group) that will be conducted in person by Rocío Cares. The focus group will be structure with an introduction (from the moderator and participants, consent and confidentiality, explanation of the rules), the discussion, including completion of a question, doubts, follow up on themes of discussion, and finally a conclusion and acknowledgement to the participants. Audio recording will be used to transcribe the answers in order to analyse them through coding. The responses from the discussion will be downloaded to a password protected One Drive folder hosted through UEA (University of East Anglia) and deleted from any other storage place within 24 hours of collection or receipt. Your email response containing the completed consent will be deleted and removed from the trash folder as soon as the attachments have been saved to this folder. The information provided will only be used

for this PhD thesis and for future journal articles reporting the main results, as well as presentations at an International Conference. Your name and affiliation will remain anonymous.

16. How much of my time will it take?

The focus group is expected to be no longer than one and a half hours. Other than the participation in the focus group, no additional time commitment is required.

17. Do I have to be in the study? Can I withdraw from the study once I've started?

Being in this study is completely voluntary and you do not have to take part. Your decision whether to participate will not affect your current or future relationship with the researchers or anyone else at the University of East Anglia.

If you decide to take part in the study and then change your mind later, you are free to withdraw at any time up to April 30th, 2024. You can do this by emailing Rocío Cares at R.Cares-Suarez@uea.ac.uk.

18. Are there any risks or costs associated with being in the study?

Aside from giving up your time, we do not expect that there will be any risks or costs associated with taking part in this study.

19. Are there any benefits associated with being in the study?

As the participation will be anonymous, there will not be any benefits associated other than being acknowledged in the thesis, journal articles and conference presentations as an anonymous participant.

20. What will happen to information about me that is collected during the study?

Completed forms returned by email will be downloaded into a password protected OneDrive folder hosted through UEA. The email used to send the completed forms will be deleted and removed from trash as soon as the data are downloaded to the password protected folder.

By providing your consent, you are agreeing to us collecting personal information about you for the purposes of this research study. Your information will only be used for the purposes outlined in this Participant Information Statement, unless you consent otherwise. Data management will follow the UK General Data Protection Regulation Act 2020 (https://www.legislation.gov.uk/ukpga/2018/12/contents/enacted) and the University of East Anglia Research Data Management Policy 2022 (https://my.uea.ac.uk/documents/20142/9487190/FINAL+Research_Data_Management_Policy_v2-0+02+11+22.pdf/9dec535e-6af2-9aa6-c417-d4cc9481fbd3?t=1667577765003).

Your information will be stored securely, and your identity/information will only be disclosed with your permission, except as required by law. You will remain anonymous, and although every effort will be made to protect your identity, there is a risk that you might be identifiable due to the nature of any examples you provide. The expectation is that you do not provide such information as you will be anonymous.

21. What if I would like further information about the study?

When you have read this information, Rocío Cares will be available to discuss it with you further and answer any questions you may have. If you would like to know more at any stage during the study, please feel free to contact Rocío Cares, PhD student, University of East Anglia, R.Cares-Suarez@uea.ac.uk, +44 07950650444.

22. Will I be told the results of the study?

You have a right to receive feedback about the overall results of this study. You can tell us that you wish to receive feedback by being sent an electronic copy of the journal article, if published, subject to your ticking the relevant box on the consent form. You would receive this electronic copy after publication in the journal.

23. What if I have a complaint or any concerns about the study?

The ethical aspects of this study have been approved under the regulations of the University of East Anglia's Science Faculty Research Ethics Committee.

If there is a problem please let me know. You can contact me via the University at the following address:

Rocío Cares

School of Environmental Sciences

University of East Anglia

NORWICH NR4 7TJ UK

R.Cares-Suarez@uea.ac.uk

If you are concerned about the way this study is being conducted or you wish to make a complaint to someone independent from the study, please contact the Head of the School of Environmental Sciences, Professor Ian Renfrew (i.renfrew@uea.ac.uk), or the Ethics Officer for the School of Environmental Sciences, Dr Helen Pallett (H.Pallett@uea.ac.uk).

24. OK, I want to take part – what do I do next?

You need to fill in the consent form and return it by email, to R.Cares-Suarez@uea.ac.uk. Please keep the information sheet.

This information sheet is for you to keep

Focus group participant information sheet (Spanish)

PhD Thesis in Environmental Sciences: "Integrating Biodiversity Offsets in the planning of EIA in Chile"

HOJA DE INFORMACIÓN AL PARTICIPANTE

1. ¿De qué se trata este estudio?

Ud está invitado a participar en la investigación de tesis de doctorado titulada "Integración de Compensación de Biodiversidad en la planificación de EIA en Chile". El propósito de esta investigación es evaluar si el Sistema de Evaluación de Impacto Ambiental (SEIA) en Chile, junto con otras herramientas de apoyo a las decisiones ambientales, está logrando una reducción de la pérdida de biodiversidad, de acuerdo con la legislación ambiental nacional vigente. Como parte de esta tesis, se investigará y evaluará la práctica chilena de EIA (Evaluación de Impacto Ambiental), considerando la experiencia, el conocimiento y las perspectivas de los actores involucrados en el proceso de EIA. Esta Hoja de Información para el Participante le informa sobre el proyecto de investigación. Saber de qué se trata le ayudará a decidir si desea participar en el estudio. Lea atentamente esta hoja y haga preguntas sobre cualquier cosa que no comprenda o sobre la que desee saber más.

La participación en este estudio de investigación es voluntaria.

2. ¿Quién dirige el estudio?

El estudio está siendo llevado a cabo por la estudiante de doctorado Rocío Cares, Facultad de Ciencias Ambientales de la Universidad de East Anglia (Inglaterra).

Rocío Cares está supervisada por:

Profesor asociado Dr. Alan Bond, Facultad de Ciencias Ambientales, Universidad de East Anglia

Profesora asociada Dra. Aldina Franco, Facultad de Ciencias Ambientales, Universidad de East Anglia

3. ¿Qué implicará el estudio para mí?

Su participación implicará completar un formulario de consentimiento y participar de un Focus Group (pequeño grupo de discusión) que será dirigido en forma presencial por Rocío Cares. El Focus Group se estructurará con una introducción (del moderador y de los participantes, consentimiento y confidencialidad, explicación de las reglas), la discusión propiamente tal, incluyendo una ronda de preguntas, explicaciones, y un seguimiento de los temas de discusión, y finalmente una conclusión y agradecimiento a los participantes. Se utilizará grabación de audio y video para transcribir las respuestas con el fin de analizarlas mediante codificación. Las respuestas de la discusión se descargarán en una carpeta One Drive protegida con contraseña cuyo servidor es UEA (Universidad de East Anglia) y se eliminarán de cualquier otro lugar de almacenamiento dentro de las 24 horas posteriores a su recolección o recepción. Su respuesta por correo electrónico que contiene el formulario de consentimiento se eliminará

y será removido de la carpeta de papelera tan pronto como los archivos adjuntos se hayan guardado en esta carpeta One Drive. La información proporcionada únicamente será utilizada para esta tesis doctoral y para futuros artículos de revistas que informen los principales resultados, así como para una presentación en una Conferencia Internacional. Su nombre y afiliación permanecerán anónimos.

4. ¿Cuánto tiempo me llevará?

El Focus Group debería tener una duración de un par de horas, incluyendo un tiempo de break y catering. Aparte de la participación en el grupo de discusión, no se requiere ningún compromiso de tiempo adicional.

5. ¿Tengo que estar en el estudio? ¿Puedo retirarme del estudio una vez que haya comenzado?

Participar en este estudio es completamente voluntario y no es necesario que participe. Su decisión de participar no afectará su relación actual o futura con los investigadores ni con ninguna otra persona de la Universidad de East Anglia.

Si decide participar en el estudio y luego cambia de opinión, puede retirarse en cualquier momento hasta el 30 de abril de 2024. Puede hacerlo enviando un correo electrónico a Rocío Cares a R.Cares-Suarez@uea.ac.uk.

6. ¿Existen riesgos o costos asociados con la participación en el estudio?

Aparte de dedicar su tiempo, no esperamos que existan riesgos o costos asociados con la participación en este estudio.

7. ¿Hay algún beneficio asociado con participar en el estudio?

Como la participación será anónima, no habrá ningún beneficio asociado más que ser reconocido en la tesis, artículos de revistas y presentaciones de congresos como participante anónimo.

8. ¿Qué pasará con la información sobre mí que se recopile durante el estudio?

Los formularios completos que se devuelvan por correo electrónico se descargarán en una carpeta de OneDrive protegida con contraseña cuyo servidor es UEA. El correo electrónico utilizado para enviar los formularios completos se eliminará y será removido de la papelera tan pronto como los datos se descarguen a la carpeta protegida con contraseña. Su participación en el Focus Group así como sus opiniones, experiencias, intervenciones, se mantendrán confidenciales.

Al brindar su consentimiento, acepta que recopilemos información personal sobre usted para los fines de este estudio de investigación. Su información solo se utilizará para los fines descritos en esta Hoja de información al participante, a menos que usted consienta lo contrario. La gestión de datos seguirá la Ley de Regulación General de Protección de Datos del Reino Unido de 2020 (https://www.legislation.gov.uk/ukpga/2018/12/contents/enacted) y la Política de Gestión de Datos de Investigación de la Universidad de East Anglia de 2022 (https:///my.uea.ac.uk/documents/20142/9487190/FINAL+Research_Data_Management_Policy_v2-0+02+11+22.pdf/9dec535e-6af2-9aa6-c417-d4cc9481fbd3?t=1667577765003).

Su información se almacenará de forma segura y su identidad/información solo se divulgará con su permiso, salvo que lo exija la ley. Usted permanecerá anónimo y, aunque se harán todos los esfuerzos posibles para proteger su identidad, existe el riesgo de que pueda ser identificable debido a la naturaleza de los ejemplos que proporcione. La expectativa es que usted no proporcione dicha información (ejemplos) ya que será anónimo.

9. ¿Qué pasa si quisiera obtener más información sobre el estudio?

Cuando haya leído esta información, Rocío Cares estará disponible para discutirla más con usted y responder a cualquier pregunta que pueda tener. Si desea obtener más información en cualquier etapa del estudio, no dude en ponerse en contacto con Rocío Cares, estudiante de doctorado, Universidad de East Anglia, R.Cares-Suarez@uea.ac.uk, +44 07950650444.

10. ¿Me informarán los resultados del estudio?

Usted tiene derecho a recibir comentarios sobre los resultados generales de este estudio. Puede indicarnos que desea recibir una copia electrónica del artículo de la revista, si se publica, sujeto a que marque la casilla correspondiente en el formulario de consentimiento. Recibirá esta copia electrónica después de su publicación en la revista.

11. ¿Qué pasa si tengo una queja o alguna inquietud sobre el estudio?

Los aspectos éticos de este estudio han sido aprobados según las regulaciones del Comité de Ética en Investigación de la Facultad de Ciencias de la Universidad de East Anglia.

Si hay algún problema, hágamelo saber. Puede contactarse conmigo a través de la Universidad en la siguiente dirección:

Rocío Cares

Facultad de Ciencias Ambientales

Universidad de East Anglia

NORWICH NR4 7TJ REINO UNIDO

R.Cares-Suarez@uea.ac.uk

Si le preocupa la forma en que se está realizando este estudio o desea presentar una queja a alguien independiente del estudio, comuníquese con el director de la Facultad de Ciencias Ambientales, el profesor Ian Renfrew (i.renfrew@uea.ac.uk), o la Oficial de Ética de la Facultad de Ciencias Ambientales, Dra. Helen Pallett (H.Pallett@uea.ac.uk).

12. Está bien, quiero participar. ¿Qué hago a continuación?

Debe completar el formulario de consentimiento y enviarlo por correo electrónico a R.Cares-Suarez@uea.ac.uk. Por favor conserve esta hoja de información.

Esta hoja de información es para que usted la conserve

Appendix 7 Focus group Consent Form

Focus group Consent Form (English)

CONSENT FORM

Title of Project: "Integrating Biodiversity Offsets in the planning of EIA in Chile"

Name of Researcher(s): Rocío Cares (PhD student)

Please tick box

1. I confirm that I have read and understood the Information Sheet provided to me for the above study/project, I have had the opportunity to ask questions and I am happy with the answers. ☐
2. I understand the purpose of the study, what I will be asked to do, and any risks/benefits involved. ☐
3. I understand that my participation is voluntary and that I am free to withdraw at any time up until April 30th, 2024, without giving a reason. ☐
4. I understand that personal information about me that is collected over the course of this project will be stored securely and will only be used for purposes that I have agreed to. I understand that information about me will only be told to others with my permission, except as required by law. ☐
5. I understand that any quotes used in this study will be anonymised. ☐
6. I agree to take part in this study. ☐
7. I would like to receive an electronic copy of the article based on the data collected through this project, if published. ☐

Name of Participant	Date	Signature

Focus group Consent Form (Spanish)

University of East Anglia

FORMULARIO DE CONSENTIMIENTO

Título del Proyecto: ““Integración de Compensación de Biodiversidad en la planificación de EIA en Chile”

Nombre de la investigadora: Rocío Cares (estudiante de PhD)

Por favor marque la casilla

1. Confirmo que he leído y comprendido la Hoja de Información al Participante que se me proporcionó para el estudio/proyecto mencionado arriba, he tenido la oportunidad de hacer preguntas y estoy satisfecho con las respuestas. ☐
2. Entiendo el propósito del estudio, lo que se me pedirá que haga y los riesgos/beneficios involucrados. ☐
3. Entiendo que mi participación es voluntaria y que soy libre de retirarme en cualquier momento hasta el 30 de abril de 2024, sin dar motivo. ☐
4. Entiendo que la información personal sobre mí que se recopile durante el transcurso de este proyecto se almacenará de forma segura y sólo se utilizará para los fines que he aceptado. Entiendo que mi información sólo se compartirá con otras personas con mi permiso, salvo que lo exija la ley. ☐
5. Entiendo que cualquier cita utilizada en este estudio será anónima. ☐
6. Acepto participar en este estudio. ☐
7. Me gustaría recibir una copia electrónica del artículo basado en los datos recopilados a través de este proyecto, si se publica. ☐

_____	_____	_____
Nombre del participante	Fecha	Firma

Appendix 8. Original text in Spanish, and *English translation*[1] for quotes in Chapter 6.

Consultant C1:

Section 6.2.1

'Yo creo que la iniciativa de sacar guías con respecto al tema biodiversidad es super interesante, pero yo creo que llevando al tema de la operatividad que conversamos recién, yo creo que la autoridad muchas veces saca guías y no tiene 100% claridad de cómo se va a operativizar esa guía'

> *'The initiative to publish guides on biodiversity is very interesting, but I think that, in relation to the issue of implementation that we just discussed, I think that the authority often publishes guides and does not have 100% clarity on how these guides are going to be put into practice'*

Section 6.2.3

'Mostraba lineamientos muy generales con respecto a la biodiversidad'

> *'It showed very general guidelines with regard to biodiversity'*

'Pero la verdad es que la guía en ese momento solamente te entrega una fórmula muy general, o sea, decía calidad y te decía que es lo que era básicamente, pero no te entregaba una fórmula en una parametrización más adecuada'

> *'The truth is that the guide at that time only gave you a very general formula which relates the quality of the site by area to calculate certain things. But it doesn't give a methodology for that'*

Section 6.2.4

'Es una guía ya mucho más formal con metodologías cuantitativas principalmente de estimación de impactos residuales y ganancias'

> *'It is a much more formal guide with quantitative methodologies mainly for estimating residual impacts and gains'*

'Si tu área de impacto es muy buena, tú vas a tener que compensar más. Y por otro lado, si tu área de compensación también es relativamente buena, vas a tener que compensar mucho más que lo que impactaste. Entonces, esa es la gracia de esta nueva guía, que intrínsecamente te mete este concepto como de capacidad de carga, o sea, si tu área es muy buena, no me puedes compensar 1:1'

> *'If your area of impact is very good* [in terms of quantity and quality of biodiversity]*, you will have to compensate more. On the other hand, if your area of compensation is also relatively good, you are going to have to compensate much more than what you impacted. So, that's the beauty of this new guide, which intrinsically brings in this*

[1] The tone of the translations is more formal than the originals.

concept of carrying capacity, that is, if your area is very good, you can't compensate 1:1'

'Es que la nueva guía fuerza los titulares a hacerse cargo de la sustentabilidad de la medida y ahí entra un poco lo que dices tú. Si la medida que tú pusiste originalmente no funciona, bueno, tendrás que ver cómo'

'The new guide forces the developers to take responsibility for the sustainability of the measure … If the measure you originally put in place doesn't work, well, you'll have to find a way to make it work'.

Section 6.3.1

'Pero, en resumen, son medidas estándares que son las típicas que uno normalmente propone en los EIA y que y que los titulares implementan'

'There are standard measures that are the typical ones and that are normally proposed in EISs [environmental report] *and that are implemented by the developers'*

'Entre comprometer un área dentro del área de influencia que no sé si la voy a ocupar, voy a obtener mi RCA y terminar obteniendo mi RCA en mano, voy a tener que volver a modificar esa RCA porque ya esa área ya no la voy a poder mitigar. O sea, no voy a poder implementar mitigación ni reparación, sino que voy a tener que sacarla. Sabes que prefiero no contar con ella e irme altiro a la compensación

'Prefer not to commit an area within the area of influence because they don't know whether they are going to use it, or maybe they're not going to be able to implement mitigation and repair. So, they prefer to move on, immediately to compensation'

Section 6.3.2

'Muchas de las medidas operativamente, no técnicamente, operativamente les costaba después implementarlas, por diferentes cosas. Entonces, hoy día lo que está pasando es que esas dos áreas están conversando más, entonces en el diseño de la medida más que lo técnico, en el diseño se incorpora el factor operativo', y agrega: "Pero en tema operativos también, o sea, oye, ¿cómo vas a llegar al área de reforestación, vamos a construir caminos?, ¿vamos a construir camino, con qué estándar?, ¿cuál va a ser el sistema de riego? ¿Vamos a tener un sistema de riego automatizado, no automatizado, las condiciones terreno da o no da? El técnico nuestro te va a decir, sabes que esa revegetación necesita riego… Pero ahí la especificidad del terreno, de los levantamientos, es lo que se empieza a conversar con este grupo operativo'

'Many of the measures were difficult to implement in practice … so nowadays, in the design of the measure, beyond the technical aspect, the operational factor is incorporated into the design [of the measure]*'*, and added: *How are you going to get to the reforestation area? Are we going to build roads? Which standard? Are we going to have an automated irrigation system, non-automated? Our technician will only tell you that revegetation needs irrigation … but all of that is what we start to discuss with this operating group'*

‘Porque también hay que entender de que estos proyectos se insertan en territorios que también tienen sus realidades. Entonces, de hecho, el proyecto algún momento se cuestionó, o sea, dijo, oye, nosotros estamos gastando una cantidad de agua, en regar estas plantas y por otro lado tenemos comunidades que no tienen acceso al agua’

> *‘We also have to understand that these projects are inserted in territories that also have their own realities. So, in fact* [the project] *at some point questioned, hey we are spending a lot of water to irrigate these plants and on the other hand we have communities that don't have access to water’*

‘Pero hoy día claro la reparación también se está se está planteando del punto de vista de, oye tengo mi instalación de faena, corté todo y voy a revegetar ahí. Entonces ahí cuál es la reparación si tú el recurso ya lo interviniste’

> *‘If you have the work installation, and you cut everything down, there is no possible reparation because you have already destroyed the resource’*

Section 6.3.3

‘Por ejemplo, el rescate y relocalización, cuando tú pescas un animal, una lagartija y la mueves para al lado, o sea, no en tu área de interés, sino que para al lado, se pasó como medida de mitigación ¿En qué sentido? En que se vendió, o sea, esta es mi interpretación. Se vendió este relato de que la mitigación también puede ser para la componente del medio ambiente’

> *‘For example, rescue and relocation, was sold as a mitigation measure, that's my interpretation. The narrative that mitigation can also be for the environmental component was sold. However, the definition of mitigation is basically to minimise the effect of your project, not to move the environmental component’*

Section 6.4.1

‘Ahora si yo te puedo decir que hoy día se ha logrado el objetivo de pérdida neta cero, no lo sé… Porque tampoco hay una trazabilidad completa con el tema de las ganancias’

> *‘I could not tell you whether the zero net loss target has been achieved today … because there is no full tracking of the gains’*

‘Lo que buscan estas guías es que tú analices la biodiversidad, algo bastante más complejo que las diferentes componentes de medio ambiente, pero te lo lleva un análisis por componente… que cuando aplicamos la guía tanto la del 2014 como la del 2022, 2023, es que tú, claro, analizas todo esto a nivel de biodiversidad, pero igual terminas analizando los impactos por componente, y tu terminas ofreciendo medidas por componente’

> *‘The aim of the guides is that you analyse biodiversity, which is far more complex than the different components of the environment … So, when we apply the 2014, 2022, 2023 guides, you analyse all of this at the biodiversity level, but you still end up analysing the impacts by component, and you end up offering measures by component’*

‘El mundo de los humedales, antiguamente se proponía el rescate de localización de humedales, que hoy día sabemos que es una medida tiene una probabilidad de éxito muy baja’

> *‘For wetlands, in the past it was proposed the rescue and relocation of wetlands, which we now know is a measure with a very low probability of success’*

‘Y la otra opción son medidas de restauración, no de reparación, de restauración, que básicamente lo que buscan es que tu provoques una mejora de la condición de tu área de compensación a través de medidas para revegetar, relocalizar, y ahí tu la metes la métrica y empiezas a evaluar, etcétera, etcétera’

> *‘Other option is restoration measures, not repair measures, but restoration measures, which basically seek an improvement in the condition of your compensation area through measures to revegetate, relocate, and there you use the metrics and evaluate’*

Section 6.4.3

‘Pero también siempre en la evaluación ambiental, salen especies más singulares que tú dices, cómo la voy a producir? No hay estudio, hay que hacer prueba y error y eso toma un tiempo’

> *‘Always in the environmental assessment, unique species come out and you don't know how you are going to reproduce them. There is no study, you have to do trial and error and that takes time’*

Section 6.5.1

‘Porque hoy día tú te comprometes más que una sobrevivencia de una determinada composición florística, o de una revegetación, tú con lo que te comprometes con tu ganancia en biodiversidad, y no es lo mismo, porque tu ganancia, porque tú te comprometes, a parte de la sobrevivencia, hoy día te están pidiendo que te comprometas a una cobertura, ojalá una composición, más que la sobrevivencia’

> ‘*more than the survival of a certain floristic composition, or a revegetation, you have to commit to a gain in biodiversity, and it is not the same thing, because your gain is related to cover, composition, more than just survival*’.

Consultant C2:

Section 6.2.1

‘Es una exigencia y pero va a depender el criterio arbitrario que pueda tener el evaluador’

> *‘It will depend on the arbitrary judgement of the evaluator’*

‘Pero en realidad claramente cómo vamos a pretender tener una buena evaluación, ya sea como de aplicabilidad de la guía… si el evaluador es un ingeniero agrónomo que no tiene experiencia en realidad, en modelación en, no sé, en todo estudio específico que las consultoras están presentando y están diciendo, bueno cumple o no con la guía?

'Really, how can we expect to have a good assessment, applicability of the guide … if the evaluator … has no experience in modelling, I don't know, in any specific study that the consultancy firms are presenting and affirm that it complies or not with the guide'

Section 6.2.2

'Es imposible llegar a hacer… porque hay una serie de fórmulas también y una serie de criterios que son imposible llegar, o sea, no sé, yo en ese momento recuerdo que hicimos también un barrido de otros estudios que pudiesen haber aplicado efectivamente las medidas de compensación de biodiversidad, como lo señala la guía y te lo aseguro, o sea, al menos de lo que yo pude ver, ninguno en términos como claros y cuantificables, lo pudo hacer'

'*It is impossible ... because there are a series of formulas and criteria that are impossible to achieve, I mean, I don't know, at that time I remember that we also made a review of other studies that could have effectively applied biodiversity compensation measures, as indicated in the guide, and I assure you, at least from what I could see, none in clear and quantifiable terms, could have done so'*

'Pero creo, o sea en este proyecto y en otros más, como la utilización como clara y efectiva de la guía de lo que a mi juicio persigue, no se utiliza'

'I believe that in this project and in others it [the national guides] *is not used clearly and effectively'*

Section 6.3.1

'Uno es como se cumple ya, logramos cumplir, pero cómo logramos cumplir de la manera más barata'

'One has to comply, but we have to manage to achieve compliance in the cheapest way'

'Entonces, como como reparo pérdida de hábitat, O como mitigo pérdida de hábitat o como reparo o pérdida de hábitat, no puedes'

'If the project impact is habitat loss, then how can you mitigate or repair habitat loss? you cannot'

Section 6.3.3

'Como medida de compensación nosotros sí propusimos en ese caso, hacer un estudio de ámbito de hogar, de lemniscatus en un sitio prioritario o en un lugar en un área protegida. En ese caso, yo no me acuerdo de la justificación que utilizamos, como aporte al conocimiento de los reptiles y al largo plazo, al menos íbamos a tener algo de ecología básica, para después hacer manejo de esa misma especie. La guía ahora, estoy totalmente de acuerdo que es imposible cuantificarlo'

'We did propose, in that case, to do a home range study of Lemniscatus in a protected area as a compensation measure', also added that *'it was as a contribution to the knowledge of reptiles and at least we were going to have some long term basic ecology,*

so later on we could manage the same species. But I totally agree that it's impossible to quantify it [as a compensation measure]*'*

Section 6.4.1

No, no creo que ningún proyecto en Chile pueda lograrlo hoy día. De ninguna manera, o sea, hay, como te decía, hay veces que tú puedes llegar a cuantificar como un poco… No sé, hacer calzar cosas para que te dé y puedas citar la Guía y puedas decir que la compensación de cero, pero creo que no.

'I don't think any project in Chile can achieve this today. You can quantify it a bit … and you can quote the Guide and you can say there is zero [net loss]*, but I don't think so'*

'Yo creo que los consultores, las empresas que han llegado a demostrar esta pérdida de biodiversidad cero, no sé, la verdad es que lo dudo, que creo que es un paquete arreglado para que la cosa te de cero. Entonces, como es tan variable la biología, yo puedo decir cualquier cosa'

'I think that the consultants, the companies that have come to demonstrate this zero biodiversity loss, I don't know, I doubt it. I think it's a package that has been arranged to give you zero. So, as biology is so variable, I could say anything'

'Pero no existe una compensación a modo de ecosistema'

'There is no compensation in terms of ecosystem'

'Lo que ves tú, lo que veo yo, cómo cambian el sistema, como va cambiando estacionalmente, porque esta cuestión es como que la biodiversidad no es estática, se va moviendo, se va corriendo, hay años que son secos, hay años que son húmedos, entonces, cómo plantear una pérdida de biodiversidad teniendo un ambiente tan dinámico. O sea, Claro si me dan los números, la puedo cuantificar. Claro, no sé, de aquí hago esto, esto lo sumo los resto y me da cero. En realidad la cosa no funciona así'

'Biodiversity is not static, it moves and changes, there are dry years, there are wet years, so how can we consider a loss of biodiversity in such a dynamic environment? I mean, if you give me the numbers, I can quantify it, of course … but, it doesn't really work like that'

Section 6.4.2

'Sin duda, o sea, como que el rescate localización es lo que se hace hoy, pero de verdad que nadie te lo asegura'

'Definitely, rescue and relocation is what you do today, but no one can say for sure if it works at all'

'Las medidas de mitigación y de compensación y de reparación, como que va a la especie en categoría de conservación, no al servicio que pueda prestar las especies dentro de un lugar'

'Mitigation, repair, and compensation measures are aimed at species in conservation status, not at the service the species may provide within a site'

Section 6.4.3

'Esa es la gran falencia que tiene Chile y todos los recursos naturales que nosotros podemos manejar. Hay inexistencia de ecología básica, o sea, para todo, entonces es imposible que nosotros podamos hoy manejar'

'That is the great flaw of Chile and for all the natural resources that we have to manage. There is a lack of basic ecology, so it is impossible for us today to manage'

Section 6.5.1

'Porque de otra forma yo encuentro en lagarto y no voy a saber si es de la población anterior o de la población nueva'

'I don't know what I'm monitoring on the day of monitoring, whether it's individuals from the previous population or just new ones'

Section 6.5.3

'En Atacama hay dos funcionarios de la Superintendencia de Medio Ambiente y somos la región que tiene la mayor cantidad de proyectos mineros, o sea ese eso, hay esos informes se van a perder el la absolutamente nada. No, nadie los va a leer nunca, nunca'

'In Atacama there are two officials from the Superintendency of the Environment and it is the region with the highest number of mining projects, in other words, these reports are going to be lost in absolutely nothing. Nobody is ever going to read them, ever'

Consultant C3:

Section 6.2.1

'A veces sucede… en donde se indican medidas que son tan grandes, son tan importantes en términos como de extensión y de trabajo, que finalmente a los servicios terminas ahí de alguna forma negociando, y ahí el término… el tema de la guía, de los temas conceptuales pasan, segundo plano, tercer plano'

'sometimes it happens … measures indicated are so big, are so important in terms of extension and work, that finally the services (the reviewers) *end up negotiating in some way, and the guide, the conceptual issues of the guide move to a second plane, third plane'*

'No sé si hay un o muchas veces un entendimiento de las guías que se que se están proponiendo, o sea que van que van saliendo, y de las directrices generales que se están estableciendo, yo diría que no'

‘I don't know if there is an understanding [by the evaluators] *of the guides that are being proposed … and of the general guides that are being established, I would say that there is not’*

Section 6.2.2

‘Estamos todavía en un en un momento en donde estamos viendo si es que es posible o no aplicarla, en general en algunos proyectos veo que es casi muy difícil, en otros no, en otros es posible. Pero depende de la de la magnitud del proyecto y de la magnitud de los elementos a compensar sí’

‘We are still at a stage where we are seeing if it is possible or not to apply it [the national guides]*, in general in some projects I see that it is very difficult, in others it is not, in others it is possible. But it depends on the magnitude of the project and the magnitude of the elements to be compensated, though’.*

‘Todavía son pocos los proyectos que tomen la guía’

‘Few projects have yet considered the guide’

‘Partiendo por lo que te comentaba que uno de los criterios para poder compensar necesita un área que esté fuera del área de influencia, que tenga características distintas del área de influencia… O sea hay un como un cruce que en este caso al poner la guía y al llevarla a cabo, al tiro al check, no lo cumples ya’

‘*One of the criteria to be able to compensate is that you need an area that is outside the area of influence, that has different characteristics from the area of influence. And this was an area that was almost overlapping the area of influence … So, there's a kind of a crossover that in this case when you put the guide and when you carry it out, when you check it, you don't meet it’*

Section 6.2.4

‘Porque ahora hay métricas, hay métricas que de alguna forma te orientan’

‘Because now there are metrics, there are metrics that kind of guide you’

Section 6.3.1

‘Pero finalmente, el factor que decide esto son los recursos que están en comprometido en esta actividad’

‘Ultimately the deciding factor, in term of costs, is the resources that are committed to this activity’

‘Hubieron componentes que fueron afectados significativamente, que fueron flora y fauna. Entonces, ahí se procedió a compensar, o sea, el sistema o la guía y la evaluación ambiental todo obliga a compensar’

‘There were components that were significantly affected, which were flora and fauna. So, compensation was made, because the [EIA] *system and the national guide obliges us to compensate’*

‘Se hace un poco practicable, sí se hace en algunos casos un poco impracticable… encontrar un área fuera del área de influencia que tenga características, y plantear medidas o actividades que vayan en pos de compensar, por ejemplo, pérdida de comunidades de Chinchilla, no se te digo algo, chinchillas de cola corta, yo creo que no se puede’

‘It becomes a bit practicable, indeed it becomes in some cases a bit impracticable [compensation]*, because finding an area outside the area of influence and proposing measures or activities to compensate, for example, the loss of Chinchilla communities, I don't know, short-tailed chinchillas, I don't think it's possible’*

Section 6.3.3

‘Pero viendo otras evaluaciones, veo que los conceptos a veces se confunden. Proponen medidas como te decía de mitigación en vez de compensación o de reparación en vez de compensación, y tratan de ingresar de esa forma’

‘Looking at other assessments, I see that the concepts are sometimes confused. They propose measures such as mitigation instead of compensation or reparation instead of compensation, and they try to enter [to the EIA system] *in that way’.*

‘En ese tiempo, en ese tiempo en particular, no solamente para este proyecto, sino que para mucho más, claro, o sea, la tendencia era, era de alguna forma, no seguir esta jerarquía… Viendo también otros estudios en ese tiempo, generalmente las compensaciones pasan de mitigación la compensación… No, no hacen un análisis’

‘at that time, not only for this project, but for many more, the tendency was, in a way, not to follow this hierarchy... Looking also at other studies at that time, generally the measures go from mitigating to compensation, they don't do an analysis’

Section 6.4.1

‘Claro, yo creo que no, yo creo que no era suficientes las medidas, no solamente los proyectos que nosotros veíamos, sino que también los proyectos que veíamos de otros titulares. Pero una vez, o actualmente veo que se está haciendo un esfuerzo… Sí, sí, eso, veo que se está haciendo actualmente ese esfuerzo, pero antes yo diría, no sé del 2022 para atrás, yo creo que muy poco’

‘I don't think so, I don't think that the measures were sufficient*, not only the projects we saw, but also projects we saw from other developers. But currently I see that an effort is being made, but I would say before 2022, it was very low’*

‘Se está haciendo el intento de establecer de alguna forma, de tomar estas métricas, pero de integrar la diversidad, pero no solamente de plantas y animales’

‘An attempt is being made to establish in some way, to take these metrics, but to integrate diversity, not only plants and animals’

Section 6.5.1

‘Son monitoreos… que evalúan cierto, ciertos elementos’

‘The monitoring assesses only certain elements’

‘Son seguimiento que, para este proyecto, yo creo que son… fueron muy a corto plazo los que se propusieron’

‘I think [the monitoring] *was very short term what they set out to do’.*

Section 6.5.2

‘A veces los hitos de seguimiento a veces es el mismo, el mismo hecho de ir a monitorear, o sea, es un informe, un informe es el hito de ir a ver’

‘The monitoring milestones sometimes is the fact of going to monitor, it is a report, a report is the milestone of going to see’

Developer D1

Section 6.3.1

‘Para nosotros eso es lo más importante, ajustar de acuerdo a la realidad y la experiencia previamente que se tenía y que también indica, también nos deja alertas de cuáles son las medidas que sabemos que son más complejas y que tenemos que reforzar alguna medida adicional de seguimiento para el éxito de estas medidas’

‘For us the most important thing is to adjust according to the reality and the experience that previously we had [referring to a previous planning permission granted] *and that also indicates which are the measures that we know that are more complex and that we have to reinforce some additional follow-up measures for the success of these measures’*

Section 6.3.2

‘De medidas que sean apropiadas al lugar, que sean ajustadas a la realidad de del área de intervención… Previo a eso ya tenemos medidas implementadas y tenemos conocimiento de también requerimientos, o sea de realidades de ajuste de las medidas’

‘Measures appropriate to the site [have to be] *corrected to the reality of the intervention area… We have prior knowledge of what can and cannot be implemented’*

‘Hay factores que lo que generan más riesgos, más alerta. Por eso es importante el seguimiento que tiene que ver principalmente con, con sequía. Tiene que ver el proceso que tienen que ver que son externos a la intervención directa de la operación tiene que ver principalmente con el tema cambio climático’

‘There are factors that generate more risks … mainly related to drought. There is an external process rather than direct intervention of the operation, which is mainly

related to climate change'

Section 6.4.1

'Plan integral de planta suelo animal, que integra distintas componentes y que por lo tanto es bastante novedoso y por lo tanto, es como bien especial y que está tan bien establecido como una medida nueva, como una propuesta nueva'

> *'We proposed a comprehensive plan for plant, animal, soil, which integrates different components and establishes a more appropriate measure'*

Developer D2

Section 6.2.2

'Porque la verdad corresponde a la naturaleza del proyecto, pero yo creo que ese en general es eso'

> *'The truth is that corresponds to the nature of the project'*

Section 6.3.1

'Porque también aquí, en general, no se inventa la rueda. Entonces, uno ve como el estado del arte, y cómo, cómo han sido otros proyectos que tienen RCA, se toma de eso como parte del del análisis previo y de ahí parte desarrollando la evaluación ambiental del proyecto'

> *'There's no need to reinvent the wheel, so, one looks at the state of the art, how other projects that have RCAs* [permission granted] *have been, one takes that as part of the previous analysis and from there one starts developing the environmental assessment of the project'*

'Aquí hay dos factores que para mí son claves, uno es el económico, sin duda es innegable. Y bueno, que la económica se relaciona directamente también con la dificultad de ejecución después de la medida'

> *'There are two factors that are key for me, one is the economic factor, which is undeniable. And the economic factor is also directly related to the difficulty of implementation of the measure'*

'Ahora bien, hay componentes y va a depender un poco de la naturaleza de cada proyecto, donde yo desde un principio sé que voy a tener que compensar'

> *'There are components* [biodiversity] *that I know from the beginning that I'm going to have to compensate, because it's going to depend on the nature of each project'*

Section 6.3.2

'Muchas veces la autoridad es bien exigente y también un poco realista, digamos en algunos casos para para hacer su contrapropuesta ante una propuesta de un titular. Y la empresa tiene que ser bien pragmática en ese sentido, porque yo podría prometer una medida muy llamativa

y que la autoridad le guste mucho, pero que en el futuro, cuando tenga que ejecutarla, me va a ser imposible, que no están dadas las condiciones porque… No sé, hay una infinidad de variables'

> *'often the authority is very demanding and also unrealistic, in some cases, in order to make a counter-proposal to a proposal from a developer, and the company has to be very pragmatic in that sense, because I could promise a very attractive measure that the authority likes very much, but in the future, when I have to implement it, it will be impossible, because the conditions are not right because, I don't know, there are an infinite number of variables'*

Section 6.3.3

'Todas mis medidas van destinadas a compensar que a reparar… entonces como parte de ese ejercicio siempre nosotros intentamos ir por la compensación porque tratamos de minimizar el impacto que genera el proyecto'

> *'All my measures are aimed at compensating rather than repairing ... so as part of that exercise we always try to go for compensation because we try to minimise the impact that the project generates'*

Section 6.5.1

'Porque al menos lo que recuerdo, los indicadores de éxito son bien sencillos, en el fondo es si la planta vive o no vive'

> *'The indicators of success are quite simple, basically it is whether the plant lives or not'*

Developer D3

Section 6.2.2

'Todo eso es muy complejo de manejar porque después el especialista tiene que justificarlo muy bien en los informes… Porque yo creo que de lograr, lograr realmente lo que lo que te piden en estas guías, que son en parámetros que a lo mejor son demostrables que se logran, pero yo creo que es una tarea difícil de lograr'

> '*It is difficult to manage because the specialist has to justify it very well in the reports ... I believe to really achieve what is asked in these guides, in parameters that can be demonstrably achieved, I believe that it is a difficult task to achieve'*

'Entonces es como difícil ahora dar una respuesta de que si fue o no fue eficiente la implementación de la de la guía, o sea, implementarla yo creo que sí resulta, pero si o si te vas con encontrando con factores externos que muchas veces cuestan manejar y que se escapan de tus manos'

> *'I believe that implementing it* [the National Guides] *does work, but you find yourself confronted with external factors that are often difficult to manage and are out of your hands'*.

‘A lo mejor te encuentras mucho con la compensación, porque por lo general, es aceptada por el mismo sistema. Es aceptada por la evaluación y es un recurso más manejable para un titular’

> *‘You might come across compensation a lot, because it is generally accepted by the* [EIA] *system. It is accepted by the assessment, and it is a more manageable resource for the developer’*

Section 6.3.1

‘No nos vamos a poner creativos con algo que o tratar de implementar algo que pueda surgir es como idea, es muy riesgoso, es muy riesgoso para este tipo de proyecto, por lo tanto siempre cumplimos con lo que está normado, con lo que nos pide la norma’

> *‘We are not going to get creative with something or try to implement something that might come up as an idea, it is very risky, it is very risky for this type of project, therefore we always comply with what is regulated, with what the regulations ask of us’*

‘Obviamente se va a evaluar otras cosas, que es lo que le interesa, por ejemplo a un titular que tiene que ver con el presupuesto’

> *‘Obviously other things are going to be evaluated, for example for a developer it is related to the budget’.*

‘Yo creo que fue porque las medidas que se definieran que son de compensación son adecuadas para este tipo de proyecto. Quizás no, no era necesario una de reparación’

> *‘I think the compensation measures that were defined were appropriate for this type of project. Maybe there was no need for a repair measure’.*

Section 6.3.2

‘Manejable desde el punto de vista de poder implementar y poder lograr el objetivo, básicamente. Porque para qué me voy a comprometer con algo que a la larga me puede generar un problema más que un beneficio?’

> *‘Manageable from the point of view of being able to implement and to be able to achieve the objective, basically. Because why am I going to commit myself to something that in the long term can generate more of a problem than a benefit?’*

‘Durante el proceso, igual se, o sea porque el papel soporta mucho, o sea, el papel te dice, no es cierto, hay que hacerlo así, hay una metodología, todo se aplica, se hace, pero también hay cosas complejas que hay que manejar durante la misma implementación. Por ejemplo, no sé, el traslado de las especies. No sé, por ejemplo, cuando hace la metodología de captura, relocalización. Independente del objetivo, de los parámetros que tienes que cumplir, dice como tú tienes que hacerlo, entonces, dice no sé, no pueden pasar dos horas, y repente tú haces el rescate y te pillaste con un taco, no sé o algo y no cumpliste con las dos horas, por decir algo’

> *During the process, because the paper supports a lot, I mean, the paper tells you you have to do it this way, there is a methodology, everything is applied, it is done, but there*

are also complex things that have to be managed during the implementation itself. For example, the transfer of species. You can't spend two hours [transferring the species]*, and suddenly you do the rescue, and you get a traffic jam, and you don't comply with the two hours'*

'Nosotros estábamos haciendo una relocalización de especies en un en un área que bueno, que estaba aprobada, se informó y todo… y en invierno tuvimos 3 períodos, 3 crecida del río, pero importantísima o sea, una cuestión que el río se salió, o sea, se inundó y todo. Entonces esa área donde yo estaba relocalizando se perdió'

'We were relocating species in an area that was approved, it was reported and everything ... and in winter we had three floods of the river ... So that area where we were relocating was lost'.

'Reparación implica además muchas otras otra actividad y tienes que tener como un entorno adecuado y además también poder implementar más recursos de todo tipo para poder llegar a una reparación, o sea, por eso es la tendencia yo creo que va también a la compensación, a lo mejor por los titulares'

'Repair also involves many other activities, and you have to have a suitable environment and also be able to implement more resources of all kinds in order to be able to achieve a repair, I mean, that's why I think the tendency is also towards compensation, especially for the developers'

Section 6.4.1

'Entonces, si tú me preguntas hoy día, si la medidas de la guía fueron eficientes, es como que yo te podría decir sí, pero no lo tengo, no puedo darte la respuesta porque no lo sé'

'So, if you ask me today if the measures in the guide were efficient, I can't give you the answer because I don't know'

Section 6.4.2

'Entonces a veces es difícil demostrar que una especie que tú sacaste de un lado, la llevaste a otro, que sobrevivió, qué es la misma, el mismo ejemplar que tú rescataste… Y ahí, la medida, no puede ser eficiente, o eficaz, dependiendo de cómo lo quieras ver, pero este complejo'

'Sometimes it is difficult to prove that a species that you took from one place, brought to another, it survived, that it is the same specimen that you rescued ... And there, the measure cannot be successful'

'En este caso, cuando hablamos de implementar compensaciones son porque hay una afectación, una especie, además que está en categoría de conservación, o sea, no es como que sean todas las especies que puedan existir en el lugar, siempre nos enfocamos en especie de objetivos. Por qué? Porque son especies más sensibles'

'In this case, when we talk about implementing compensation, it is because species in conservation status are affected, in other words, it is not all the species that may exist in the place, we always focus on target species. Why? Because they are more sensitive species'

Section 6.4.3

'Cuesta encontrar el especialista en temas de reparación… Sin embargo, igual existen, no sé las Universidades, existen otros organismos que no son del Estado que se dedican también a hacer estudios y cosas, pero falta creo yo, o sea, el tema de investigación y eso creo que Chile, ahí estamos un poco débiles en ese sentido, por eso muchos se van a otro país a hacer muchas cosas, porque acá es como muy limitado'

'It is difficult to find a specialist in repair [biodiversity]*... There are universities, there are other organisations that are not state bodies that are also dedicated to studies, but I think there is a lack of research and I think Chile is a bit weak in that sense, that's why many people go to another country to do many things, because here it's very limited'*

Section 6.5.1

'Yo creo que es una tarea difícil, difícil, difícil de demostrar. Y los especialistas ahí tratan de hacerlo, porque hay que cumplir con los porcentajes y un montón de cosas, pero, pero yo creo que en la práctica, la metodología, es difícil demostrar que se cumpla'

'I think it is a difficult task, difficult to demonstrate. And the specialists try to do it, because you have to comply with the percentages and a lot of things, but I think that in practice, the methodology, it is difficult to demonstrate compliance'

Section 6.5.3

'Entonces creo que sin perjuicio que uno deja las cosas en las manos de los especialistas, creo que faltan especialistas que fiscalicen'

'I think there is a lack of specialists for monitoring'

'Pero después como que la participación llega hasta ahí, y después claro los mismos que te revisaron después no te hacen un seguimiento'

'Their involvement stops there [the participation of the reviewers]*, and then the same people who review [in the assessment process] don't follow up afterwards'*

Evaluator E1

Section 6.2.1

'Por darte un ejemplo, pasa mucho de que algunos servicios levantan temas que son netamente sectoriales, que no tienen que ver con la evaluación ambiental… esa observación nosotros no las consideramos. Y solamente dejamos aquí observaciones que son netamente que son estrictamente ambientales'

'It happens a lot that some services (reviewers) *raise issues that have nothing to do with environmental assessment … we do not consider these observations. And we only leave here observations that are purely strictly environmental'*.

Section 6.2.2

'Porque puede pasar de que el titular utilice la metodología, pero lo utilice en forma errónea o no presenta todo los antecedente para poder justificar cada valor de los parámetros que establece la metodología'

'It can happen that the developer uses the methodology but uses it erroneously or does not present all the background information to be able to justify each value of the parameters established by the methodology'

Section 6.2.3

'También mencionar de que esa guía era bastante teórica'

'That guide was rather theoretical'

Section 6.2.4

'Entonces a ver, al poder cuantificar, pasar a número ahí es más fácil de verificar si efectivamente se está logrando una pérdida neta cero o una ganancia, entonces con las nuevas, con la guía metodológica, ahí se logra, como ya aterrizar, ya no pasar tanto en lo teórico, sino ya una metodología práctica, que nosotros podemos ya se por un lado, exigir a los titulares.

'By being able to quantify, to put a number, it is easier to verify whether a zero net loss or gain is actually being achieved, so with the methodological guide, it is possible … not only in theory, but in a practical methodology, so that we can, on the one hand, demand that to the developers'

Section 6.3.1

'Antes que existieran estas guías y criterios, estaban estas medidas estándar'

'There are standard measures'

Section 6.4.1

'Si bien no estaría verificando que haya una pérdida neta cero si está verificando de que esta medida de reforestación en este ejemplo que estoy dando, se está implementando según lo que se propuso en la evaluación y por tanto con eso, aunque no se está verificando la pérdida neta cero, si está verificando que la medida se implemente, según lo evaluado'

'Although it is not verifying zero net loss, it is verifying that the measure is implemented'.

Section 6.5.1

‘Falta precisar, falta precisar, ya sea en lugar de implementación, cuáles son los indicadores que se debe monitorear para acreditar que la medida se está aplicando de forma cómo, como se evaluó en el estudio de impacto ambiental’

> *‘The indicators that must be monitored to prove that the measure is being applied in the way it was assessed in the environmental impact study need to be specified’*

Evaluator E2

Section 6.2.1

‘Muchos casos… de descoordinación intersectorial, o donde OAECAS se pasan para la punta por decirlo de alguna manera, se pronuncia más de lo que deben, o exigen más de lo que… saliendose un poco de sus competencias’

> *‘Many cases ... of inter-sectoral lack of coordination, where they* [reviewers] *pronounce more than they should, or demand more than they should, going a little bit beyond their competences’*

‘Ahora claramente son muchas las regiones del país, los evaluadores tienen más o menos experiencia, hay gente nueva… Entonces si tú me preguntas están familiarizados? Yo te diría deben estar familiarizados, ahora el hecho de que algunos lo hagan mejor o no que otros, eso ya es como parte de la vida digamos, como que es parte del aprendizaje porque siempre los documentos tienen que irse incorporando’

> *‘Now clearly there are many regions in the country, the evaluators have more or less experience, there are new people... So, if you ask me, are they familiar?* [with the national guides] *I would say they must be familiar, now the fact that some do it better than others, that's part of life, let's say, it's part of the learning process because the documents always have to be incorporated’.*

Section 6.2.2

‘Porque en el fondo la guía del 2014, tiene principios pero luego estos principios eran interpretados o llevados a la práctica de manera diversa porque no había una manera que el servicio estuviera indicando de cómo hacerlo’

> *‘Basically the 2014 guide has principles but then these principles were interpreted or put into practice in different ways because there was no way that the service was indicating how to do it’*

Section 6.2.4

‘En el pasado no había como una visión muy integral de una perspectiva ecosistémica, había una perspectiva más puntual de especies, de ciertas especies en categoría de conservación, entonces cuando se hablaba de biodiversidad en realidad, no había como una no se completaba todo el significado de lo que implica biodiversidad en todos sus niveles de organización desde el paisaje, ecosistema, a población, genético para qué decir… entonces claro eso es lo que viene a hacer la guía, ese es el por qué de esta guía metodológica, porque ataca esto mismo que tú expresas y le da una cuantificación, por primera vez una forma de cuantificar’

'In the past there was not a very comprehensive vision of an ecosystemic perspective, therewas a more specific perspective of species, of certain species in a conservation category, so when we talked about biodiversity in reality, there was not a complete meaning of what biodiversity implies at all levels of organisation, from the landscape, ecosystem, to population, genetic … So that is the reason for this methodological guide, it gives a quantification, for the first time a way of quantifying'

Section 6.5.3

'Corresponde algo de la SMA porque nosotros no vemos si es que son exitosa o no. No evaluamos los proyectos ex post, como una vez que ya está funcionando nosotros no recibimos ni gestionamos ni levantamos información al respect, y la SMA no observa los proyectos dentro del SEIA, puede ser mirado de algunas perspectivas como un poco como una falta'

'It corresponds to the SMA [the monitoring] *because we do not verify if they are successful or not* [the measures]. *The fact that we do not evaluate projects ex post, and the SMA does not review projects within the assessment process, it can be seen from some perspectives as a flaw'*

Monitoring officer M1

Section 6.4.1

'Entonces yo dudo mucho yo dudo con toda mi alma que si en alguna parte sale de que la pérdida de biodiversidad neta tiene que ser 0 con el nivel de información que estaba en ese informe… pongo mis manos al fuego de que esa información no está'

'I doubt that very much if anywhere it says that the biodiversity net loss has to be 0, with the level of information that was in that report and that we checked against, I assure you it's not there'.

Section 6.4.4

'Caracterizar un área en términos de biodiversidad no solamente tiene multiplicidad de especies que ni siquiera sabe están clasificadas, que puede llegar hasta género, no más. O puede llegar hasta grupo porque no sabes cómo identificarla, sino que puedes verla en distintas fases, puedes ver una huella, puedes ver un huevo. O puedes ver, oído, por un tema de pájaros, entonces por eso tienes muchas complejidades adicionales'

'Characterising an area in terms of biodiversity has a multiplicity of species that you don't even know if they are classified… Or you don't know how to identify it, because you can see it in different stages, you can see a footprint, you can see an egg, you can hear a bird, so that's why you have a lot of additional complexities'

Section 6.5.1

'Yo pensaría que si por algún motivo no se puede calcular es porque sencillamente no reportaron toda la información que debería haber reportado'

'If for some reason it cannot be calculated [the effectiveness of the measure], *it is because they simply did not report all the information that should have been reported'*

Section 6.5.2

'El titular es el que manda la información en la RCA, por lo tanto, en ese plan debería estar clarísimo toda la información que debería enviar el titular para que la SMA agarre esto, agarre esto otro y diga, hay o no hay pérdida neta cero de biodiversidad. No que sea la SMA la que diga, oye, cómo vamos a ver esto? Porque, en el fondo, si tú no pediste la información desde el origen, entonces va a ser muy difícil que esté toda la información en el momento de la fiscalización'

'The monitoring planning established in the RCA [planning permission] *should be very clear with all the information that the developer should deliver, so the SMA* [Superintendency of the Environment] *can take this and say whether there is or there is not zero net loss of biodiversity… but for that you need to have the primary information that allows you to do the calculations'*

'Porque no te pide metodología, es reporte todo'

'Everything is reported, but without a methodology'

'Pero que puede complicar mucho la fiscalización posterior porque se hace cada elemento lo hace super diferente, la estandarización y la generalización es muy baja, entonces hay mucho desgaste de la superintendencia'

'*It makes each element very different, standardisation and generalisation are very low, so there is a lot of burnouts in the superintendence'*

Section 6.5.3

'Pero sobre todo, sobre todo por un tema de capacidad'

'There is a lack of capacity in the SMA

'Ese conocimiento empírico de las medidas que deberían ser más solicitadas y de las medidas que, por favor, no vuelvan a generar esto porque esto no funciona… Ese conocimiento de alguna u otra manera se debería traspasar al servicio de evaluación ambiental y a todos sus evaluadores'

'We have the empirical knowledge of the measures that should be more requested and the measures that… do not work. That knowledge should somehow be transferred to the Environmental Assessment Service and all its evaluators'

Monitoring officer M2

Section 6.3.2

‘Porque las medidas pueden sonar super bien en el papel, pero cuando tú lo vas a analizar y cuando empiezas a fiscalizar la ejecución de la medida como tal, la ejecución por una parte es muy mala en términos generales… Entonces están mal implementadas’

> *‘The measures may sound very good on paper, but when you go to analyse them and when you start to monitor the execution of the measure as such, the execution is very bad’*, and added: *‘they are* [the measures] *badly implemented’*.

Section 6.4.2

‘La necesidad de que haya una una revisión de las medidas que quedan establecidas en las RCA. ¿Por qué? Porque muchas medidas no realmente no logran el objetivo como que no, no se logra ni la pérdida neta cero ni la adicionalidad’

> *‘There is a need for a review of the measures established in the RCAs* [planning permission]. *Why? Because many measures do not really achieve the objective, neither zero net loss nor additionality’*.

Section 6.4.4

‘Porque hasta ahora es super poco como el el estudio de los efectos sinérgicos que se generan, producto de los distintos proyectos o ejecución de los distintos proyectos’

> *‘So far, there has been very little study of the synergy effects generated by the implementation of several projects’*

Section 6.5.1

‘No quedan medios de ni de verificación ni indicadores de cumplimiento, ni ni seguimiento, encuentro yo, como adecuados para poder definir si efectivamente se está logrando el objetivo o no’

> *‘There are no means of verification or indicators of compliance, or monitoring, I find, as adequate to be able to define whether or not the objective is actually being achieved’*

Section 6.5.2

Los informes de seguimiento todavía son pobres, así como en cuanto a la cantidad y calidad de información, especialmente en calidad’

> *‘Monitoring reports are still poor, as in quantity and quality of information, especially in terms of quality’*.

‘Si como que revisas las RCA algunos indicadores de cumplimiento son bastante poco lógicos. Es se enviará un reporte. Ya, y ese es el indicador de cumplimiento respecto a una medida ponte tú de rescate, entonces tu dices ya, qué es lo que yo quiero? Quiero que me remitan un documento, es ese es como mi objetivo?’

> *‘If you look at the RCAs* [planning permission] *some of the compliance indicators are quite illogical: “A report will be sent”. And that is the compliance indicator for a*

rescue and relocation measure'.

Section 6.5.3

'El nivel que hay de como de incidencia por parte de los servicios en cuanto a la fiscalización, recién está como partiendo'

> *'The level of incidence by the services* [reviewers] *in terms of monitoring is only just beginning'*.

'No existe todavía un trabajo tan conjunto entre ambos servicios, donde exista como algo de retroalimentación, donde tú les digas sabes qué? Estas medidas están de tal forma, necesitamos que se mejore esto y desde la evaluación se puede hacer e incorporar la lógica'

> *'There is still no such a work together between the two services* [Environmental Assessment Service and Superintendency of the Environment]*, where there is some kind of feedback, to said we need to improve these measures and from the evaluation it can be done and incorporated'*

Reviewer R1

Section 6.2.2

'En ocasiones no, efectivamente, el titular no las presenta de tal manera. Y efectivamente, es donde uno tiene que hacer las observaciones correspondientes como servicio a objeto de que exista pérdida neta cero en el fondo'

> *'Sometimes not, indeed, the developer does not present them* [the requirements of the guide] *in such a way. And indeed, this is where one has to make the corresponding observations as a service* [reviewer] *in order to ensure that they are fulfilled'*.

Section 6.5.1

'Lo que pasa que muchas veces los indicadores que se plantean son super malos y son super vagos, entonces ahí dificulta un poco tener... Los indicadores tienen que ser cuantificable, tienen que ser medidos en el tiempo, etcétera. Entonces, es ahí yo creo que donde a veces dificulta un poco asegurar que la medida sea exitosa'

> *'Many times the indicators that are proposed are very bad and very vague, so it is difficult* [to verify]. *The indicators have to be quantifiable, they have to be measured over time, so that's where I think sometimes it's a bit difficult to ensure that the measure is successful'*

Reviewer R2

Section 6.2.2

'Todo el tema de la de la métrica, es lo que más complica'

> *'The issue about the metrics* [in the guide] *is the most complicated'*

‘Entonces después se mejoraron, pero efectivamente daba para interpretaciones ya y al final, al final eran inmanejable las cifras’

‘It did give room for interpretation and in the end, the numbers [quantifying biodiversity] *were unmanageable’*

‘Pero insisto, no es un problema del método, es un problema de la interpretación que se le da’

‘Is not a problem of the method [in the National Guides]*, it is a problem of the interpretation given to it’*

Section 6.2.3

‘Es que la del 2014 era muy mala. Era muy mala porque era una copia del BBOP sin sacar todo los criterios que tenían el BBOP’

‘it's just that the 2014 one was very bad. It was very bad because it was a copy of the BBOP without taking out all the criteria that the BBOP had’

Section 6.4.1

‘El enfoque sistémico, no aparece en la evaluación ambiental, aún cuando lo dicen, lo define, no hay una instancia de integrar todo. Entonces, la gran falencia está en que no necesariamente te estás haciendo cargo de todo lo que se está perdiendo’

‘The systemic approach does not appear in the environmental assessment, even when they say it, they define it, there is no instance of integrating everything’ and added: *‘So, the big flaw is that you are not necessarily taking care of everything that is being lost’*.

‘Sí, sí, efectivamente, por lo menos en las últimas se han trabajado con indicadores que son más cuantitativos. Ya, pero aun así, pero aún así, si la observación es si efectivamente esa medida está bien calculado, o no respecto al número de afectación’

‘Indeed, at least in the last few years we have worked with indicators that are more quantitative. But even so, the observation is whether or not the number of [biodiversity] *affected is well calculated’*.

Section 6.4.2

‘Y sabemos que hay medidas que no sirven, el rescate y relocalización es una medida que tiene cero impacto para hacerse cargo del impacto en fauna’

‘We know that there are measures that do not work, rescue and relocation is a measure that has zero impact to deal with the impact on fauna’

‘¿Por qué se sigue aprobando? Primero, porque el titular la propone ya y entendamos como titular a las consultoras. Se aseguran trabajo post RCA. Ya y es fácil de hacer y todo el mundo la hace, se ha copiado desde el inicio. Pero cuando tu entras en el debate técnico, todo el mundo sabe que la medida no funciona’

'Why does it continue to be approved? First, because developers and consultants are already proposing it, so they ensure post RCA [planning permission] *work ... and it is easy to do and everybody does it, it has been copied from the beginning. But when you get into the technical debate, everybody knows that the measure doesn't work'*

'Dentro de un plan integral, todo lo que es reparación y todo lo que es disminución de amenazas son los que efectivamente te aportan al proceso de ganancia de la medida'

'Within a comprehensive plan, everything that is restoration and threat reduction is what effectively contributes to the process of gains'

Section 6.4.3

'Entonces este es un tema que todavía estamos con los conceptos de ecología clásica y esto, esto es bueno de transferencia económica ambiental, estamos lejos de incorporarlos en los planes de estudio'

'We are still with the concepts of classical ecology, so we are far from incorporating them into the EIA process'

Section 6.4.4

'Efectivamente, va a depender de la complejidad que tengan los ecosistemas, con lo que tú estás trabajando para ver si la línea base basta… Por lo tanto, uno parte de la premisa de que, efectivamente, los impactos están bien cuantificados, ahí donde de repente encontramos algunos problemas'

'It will depend on the complexity of the ecosystems, on what you are working with to see if the baseline is enough… Therefore, one starts from the premise that, indeed, the impacts are well quantified, that is where we suddenly find some problems'.

Section 6.5.1

'Lo que nosotros estamos haciendo como servicio es ponerle indicadores más claros'

'We are doing as a reviewer is to ask for clearer indicators [of success]'.

Appendix 9. Original text in Spanish, and *English translation*[2] for quotes in Chapter 7

Evaluator E

Section 7.2.1

'Es que la idea es que los titulares de proyecto junto con sus consultores diseñen un proyecto que ya en su diseño traiga las medidas de minimización, mitigación incorporadas, a fin de que los impactos que evaluamos sean ya los que son insalvables, que no tenemos tecnología, no tenemos forma de mover el proyecto para que esté y centrarnos en eso… Entonces, por eso la etapa de diseño es fundamental para acotar los impactos que voy a tener que mitigar, reparar o compensar'

> *"The idea is that the developer, with their consultants, design a project that already includes minimisation and mitigation measures in its design, so the impacts that we evaluate are those that are unbridgeable, that we don't have the technology, we have no way of moving the project… So that is why the design stage is critical to narrow down the impacts that we are going to have to mitigate, repair or compensate for"*

Section 7.2.2

'Tanto los consultores titulares como los mismos servicios, vean esto como un ecosistema y un todo, como que en general todos ven flora, fauna, vegetación, y no logran ver ecosistémicamente todo la evaluación de impacto, sino que la hacen por componente'

> *"Both the consultants and the evaluators have to see this as an ecosystem and as a whole, in general they all see flora, fauna, vegetation, and they do not manage to see the whole impact assessment in the ecosystem but do it by component".*

Section 7.5.1

'Aquí tienes el tema del seguimiento, de cómo se comporta la medida de compensación biodiversidad para adoptar esta pérdida cero, tiene que quedar súper clara y establecida la RCA para que la SMA pueda fiscalizar'

> *"The monitoring to verify the zero net loss has to be very clear and established in the permission planning in order that the SMA* [Superintendency of the Environment] *can monitor"*

Section 7.6.1

'Bueno, de hecho, un tema que ha sido como recurrente es lo que es la revisión de los criterios de evaluación'

> *"In fact, one issue that has been recurrent is the revision of the evaluation criteria"*

'Una vez que logremos que todo esto sea sistemático, ahí recién vas a poder generar sinergia entre el SAG, CONAF, Subpesca, Acuicultura, servicio de biodiversidad, para poder hacer,

[2] The tone of the translations is more formal than the originals.

como digo yo, un monitoreo de seguimiento de compensación de biodiversidad que entrecruza todos los factores.

> *"Once we make all this systematic, then we will be able to generate synergies between the agencies in order to be able to monitor biodiversity offsets in a way that crosses all the factors"*

Section 7.6.2

'Entonces, aquí todo lo que es la experiencia adquirida de otros proyectos, de la Universidad, de tesis, son insumos para que aquí quien está desarrollando un proyecto, pueda poner en práctica esto mayor escala, como quizás falta incentivar un trabajo más colaborativo entre los privados y las universidades para hacer desarrollo de tesis de pregrado, de posgrado, a fin de ir escalando estas compensaciones y que sean efectivas'

> *"There is a need to encourage more collaborative work between the private sector and universities to develop undergraduate and postgraduate theses, in order to scale up knowledge in terms of compensation and make it effective"*

'Y que antes de trabajar el plan se junte con académicos, titulares, para recoger la experiencia de cuáles son las medidas de compensación que han funcionado, cómo han funcionado, cuánto tiempo se requiere el seguimiento, para empezar ya a dimensionar esto'

> *"Before working on the studies, to meet with academics, to gather the experience of what compensation measures have worked, how they have worked, and how long monitoring is required"*

Consultant C

Section 7.2.1

'Si uno realmente le diera prioridad a esa jerarquía, lo que haría es que deberían disminuir las medidas de compensación de biodiversidad'

> *"If the mitigation hierarchy were actually prioritised, it would mean that compensation measures would have to be reduced".*

'Porque al día de hoy no hay ningún incentivo para la alternativa del proyecto'

> *"Today there is no incentive for the project to analyse alternatives"*

'Mira yo me atrevería a decir que los proyectos lineales tienen una mayor probabilidad de analizar alternativas. Pero proyectos areales, o sea el yacimiento está ahí, no tengo como moverme'

> *"Linear projects have a higher probability of analysing alternatives, but for areal projects, the mining site is there, they have no way to move to another location"*

'Y pasa harto, porque de repente uno va, no sé, tengo un problema x, y tú vas, no sé, yo voy a la CONAF, voy al SAG, y digo, oye, pero entonces, ¿qué alternativa tenemos? Y muchas veces

tú te encuentras con que, ah no sé, uds tienen que proponer'

> *"You often ask the agencies* [involved in the assessment process] *what alternative do we have? And they don't know. They say that you propose it"*.

Section 7.3.1

'Por eso yo te decía que antes debiese haber un análisis preliminar que te vea la factibilidad de tu proyecto, pero también de los compromisos que va a adquirir'

> *"There should be a preliminary analysis of the feasibility of the measures that you are going to develop"*

'Tal vez, uno podría generar una instancia de tener una hoja de ruta que te entregue todo, o a los servicios como a ustedes como el SEA. Pero tal vez que esté dónde lo vas a hacer, que vas a lograr, aquí está el kmz, aquí están los shp, esto es lo que yo voy a monitorear en tal año, esto lo que quiero lograr, esta es mi parcela de control. El tema es que claro, después eso quede en una hoja trazable, que no tengas que ir a buscar el dato a la adenda uno, al anexo… al apéndice del anexo tanto'

> *"There should be a roadmap that gives you everything, where are you going to do it [implement the measures], what are you going to achieve, this is the maps, this is what I am going to monitor, the year, this is what I want to achieve, this is my control plot. But all in a traceable sheet, so you don't have to go to other documents to look for the data"*.

Section 7.3.2

'Entonces yo creo que acá, aparte del tema técnico hay un tema también de cómo se relacionan las medidas con el tipo de proyecto'

> *"Measures should be related to the size of the project"*.

Section 7.4.1

'Pero hoy día sabemos que es una medida que no es sustentable en el tiempo'

> *"If a measure is not sustainable over time, I can no longer propose that"*.

Monitoring Officer M

Section 7.2.1

'Si no se les facilita a las titulares alternativas de medidas que no sean de compensación, sino que sean de las otras etapas previas, y no se les da esa información digamos ya masticada, no están los incentivos económicos para que ellos exploren diferentes alternativas'

> *"If the developers are not provided with alternative measures that are not compensation measures, but rather from the other stages in the mitigation hierarchy, there are no economic incentives for them to explore different alternatives. You need*

an assessment of the design and implementation of the measure, in order to have feedback into the design and proposal of measures"

'Por último podría generarse una tipología de proyecto, y ya sabes en qué tipología de proyectos la compensación es el camino lógico versus otro proyecto que en verdad, ahí deberían estar súper enfocados'

"You could generate a typology of projects, knowing in which typology of projects compensation is the logical way, against another projects that it really is not".

Section 7.2.2

'Pero yo esperaría de que hubiera una manifestación explícita por parte de los evaluadores y obviamente por parte de los titulares del proyecto, de decir bueno esta medida, por ejemplo si es una medida de compensación, 'yo intenté evitar', y que pongan explícitamente los argumentos: 'saben qué, que no se puede'

"It should be expected [to see] *an explicit statement from the developers if they are proposing a compensation measure: I tried to avoid but it can't be done, and why"*.

Section 7.3.1

Garantizar la implementación efectiva de la medida es cómo tu medida fue diseñada, eso es como básico. Acá hay un incentivo lógico que los titulares del proyecto para, ya que me aprobaron la medida, tengo un incentivo lógico a que la medida me resulte lo más barato posible la implementación'

"The basic thing is to ensure the effective implementation of the measure as it was designed, otherwise, there could be a logical incentive from the developers to make the measure as cheap as possible to implement

Section 7.4.1

'Entonces debería haber algún mecanismo que me permita hacer adaptaciones, que eso es, yo creo que es lo más difícil, lo más medular del tema, o sea el manejo adaptativo es aplicable en temas de biodiversidad y existe por algo, todo el mundo científico dice que tiene que estar permanentemente monitoreando para ver si el camino que estás siguiendo sirve o no sirve'

"There should be some mechanism that allows me to make adaptations, which is, I think, the most difficult, the most central part of the issue. Adaptive management is applicable to biodiversity issues and it exists for a reason, the whole scientific world says that you have to be permanently monitoring to see if the path you are following is working or not"

'Y la retroalimentación no es solamente la medida es exitosa, que obviamente es súper bueno, si no el fracaso, el fracaso. No basarse solamente en lo bueno, pero tener la causalidad de por qué funcionó o no'

"There should be a proper monitoring and assessment of the measure, and good feedback. Not only in terms of whether the measure was successful or not, but also the

failure, because that will allow you to know why it did or did not work"

'Entonces para este tema de biodiversidad, es bien difícil garantizar la implementación efectiva si no se tiene obviamente el conocimiento de las medidas que realmente funcionan'

"For the biodiversity issue, it is very difficult to ensure effective implementation if you don't have the knowledge of the measures that actually work"

Section 7.5.1

'Entonces la medida tiene que ser diseñada para que la fiscalización sea lo más eficiente posible'

"The measure has to be designed to make the monitoring as efficient as possible".

Environment Ministry Officer A

Section 7.2.1

'En el fondo es promover la mitigación y la reparación más que la compensación, no tiene que ser barata la compensación porque es cara'

"The idea is to promote mitigation and repair rather than compensation, compensation does not have to be cheap because it is expensive",

'Por ese mismo motivo desincentivar al titular de que su proyecto lo instale en ese lugar a través de los costos'

"The costs [of the compensation measures] *should be a disincentive to the proponent to develop the project in that location"*

'Entonces, por lo menos la guía deja al titular la decision en base a lo caro que le va a salir y se espera que mientras más caro sea, se desincentive más la ubicación del proyecto en ese lugar'

"The national guide leaves the decision to the developer based on how expensive it will be [the compensation measures]*, and it is expected that the more expensive it is, the more disincentive there will be to locate the project there"*.

Section 7.2.2

'La jerarquía de mitigación, hay que aplicarla, o sea, un yo creo que es uno de los objetivos más importantes es que hay que aplicarla, porque si no vamos a estar afectando a todos los ecosistemas de forma irreversible'

"The mitigation hierarchy must be applied, I believe that one of the most important objectives is that it must be applied, because otherwise we will be affecting all ecosystems irreversibly".

Section 7.3.1

‘Darle la facilidad a los titulares para que ellos puedan entregar ese monitoreo de cierta forma, o sea, como con reglas claras, en cierto formato, y también exigir que haya una trazabilidad de lo que van reportando, o sea, quizá no sean así como informes del monitoreo de LA vez, sino que ellos mismos puedan mostrar de cierta forma la ganancia, o sea, en la vez pasada, por ejemplo el monitoreo de no sé diciembre del año pasado mostró esto, en el de abril vamos acá. Que ellos mismos puedan mostrar la trazabilidad’

> *“The developer should deliver the monitoring in a certain way, with clear rules, in a certain format, and also showing a traceability of what they are reporting, in order they can show the biodiversity gains”.*

Section 7.3.2

Muchas veces el área influencia no está bien determinada… Es un área mucho más grande de la que los titulares muchas veces, proponen, entonces ahí, por un lado, yo creo que eso, o sea, quizás está mal dibujada la influencia real, porque aparte también se afecta un componente como un ecosistema.

> *“Sometimes the area of influence is poorly determined… is a much larger area than what the developers often propose, and that affects a component such as an ecosystem”.*

Section 7.5.1

‘El tema de hasta hace muy poco el tema de de ir reportando los compromisos de la RCA, el monitoreo, no aportaba mucho, no había cómo hacer el seguimiento a eso, por lo mismos formatos de cómo se piden esos monitoreos, muchas veces son PDF, archivo que nadie los revisa… O sea, que no entregaran ese tipo de informe que no pueden ser utilizables ni tampoco evaluables con respecto a otros instrumentos, la idea es que esto fuera más espacializado, que fuera más fácil de monitorear’

> *“Until very recently, monitoring did not contribute much, there was no way to follow up on it because the format in which monitoring was requested was often in PDF format, files that nobody checked… such a report cannot be usable and cannot be assessed against other instruments, the idea is to make this easier to monitor*

Section 7.6.1

‘No si es que tiene que haber una coordinación de los servicios. entonces ahí yo creo que la pega de como para alinear todo eso es del SEA, el SEA tiene que alinear a los servicios, los OAECAS con instrucciones claras’

> *“There has to be a coordination of the agencies. The job to align all this belongs to the Environmental Assessment Service, they have to align the agencies and give clear instructions”*

‘Falta utilizarla y también falta también generar experiencia porque la guía igual se va a poder mejorar’

> *“It needs to be used* [the national guides] *and experience needs to be gained because the guide can still be improved”*

Specialist G1

Section 7.2.1

‘Y entonces también justamente se pierde como una un espacio en el cual se puede, como valorar si es que se han hecho realmente esos esfuerzos de mitigación previa. No, no existe el espacio entonces’

“Miss the opportunity to assess whether prior mitigation efforts have actually been made”

‘Yo creo que hay que visibilizar y muchas empresas lo tienen clarísimo de que las medidas de compensación pueden ser como baratas en el corto plazo, en el sentido que te aprueban el Proyecto, pero un mega cacho en el largo plazo porque no funcionan, porque salen muy caras de implementar, inviable de implementar’

> *“Compensation measures can be cheap in the short term, but complicated in the long term because they do not work, because they are very expensive to implement, sometimes they are unfeasible to implement”*

Section 7.2.2

‘Ellos hacen estas capacitaciones a las consultoras y pueden decir miren, nosotros vamos a priorizar y vamos a pedirles que nos digan cuáles son las medidas de mitigación, aunque hayan sido previas al ingreso del proyecto y cuáles son las medidas de reparación, si no tiene medidas de reparación, bueno, pero lo tiene que poner explícitamente’

> *“The Environmental Assessment Services should ask the consultants which are the mitigation measures, even if they have been prior to the submission of the* project [to the assessment process] *and which are the repair measures. If there are no repair measures, it has to be explicitly stated”*.

‘Si yo defino que mi foco de impacto son los individuos, efectivamente si yo los ahuyento, estoy evitando el impacto sobre el individuo, pero sobre la especie o la población, igualmente hay un impacto. O sea, hay, hay un énfasis en la regulación chilena, que es como sobre las especies, pero de ahí no sale mucho, así como pensar si es sobre la población específica, o si es más bien el ecosistema’

> “*If I define the focus of a measure to be an individual of a species, I am avoiding the impact on the individual, but there is still an impact on the species or the population. Therefore, you need to think whether the impact it is about the species, the population, or the ecosystem”*

Section 7.4.1

‘Pero hay que aceptar también un nivel de incertidumbre en lo que se está proponiendo y realmente permitir que los esfuerzos se direccionan hacia lo que sea más efectivo… y si eso implica modificar en algo la la medida que se propuso inicialmente o no ser tan preciso, lo que se propuso inicialmente, pucha debía ser existir ese espacio y no existe’

"We must accept a level of uncertainty in what is being proposed and really allow efforts to be directed towards what is most effective… And if that means modifying the measure that was initially proposed, well, there should be this opportunity, but it doesn't exist".

Section 7.6.1

'Siempre está el problema como de que los organismos evaluadores opinan sobre cosas que no les competen o que no, que no saben, pero eso se supone que lo resuelve el propio SEA cuando hace, cuando consolida la información, y también el hecho de que hubiese un ente más capacitado y más informado'

"*There is always the problem that the agencies give their opinion on things that are not their responsibility or that they do not know… there should be a more qualified and more informed entity"*

'Yo creo que, claro, la contraparte del Estado, más allá de solo el SEA, pero del Estado, tiene que tener esas herramientas y tiene que tener esas definiciones claras y transversalizadas en quienes opinan en el instrument'

"The State has to have these instruments and clear and mainstreamed definitions for those who have a say in the matter".

O sea, los evaluadores tienen que estar bien capacitados y tienen que tener claridad de que es qué es acceptable como medida y que no, y eso es muy entendible que hoy día no ocurre porque como te digo, están sobrepasados, no necesariamente tienen los conocimientos específicos para abordar los temas.

"The evaluators have to be well trained and have to be clear about what is acceptable as a measure and what is not, and it is very understandable that this is not happening today because they are overwhelmed, they do not necessarily have the specific knowledge to address the issues"

Section 7.6.2

'Que es el problema de que son los titulares de proyecto los que pagan a las consultoras y la y el incentivo de ambos es finalmente que el proyecto se apruebe lo más rápido posible, y contenga la menor medida, las menores medidas, impactos identificados y medidas posibles y revertir eso, esa lógica que que digamos un tremendo estudio que te presentan con miles de páginas y que lo tiene que repetir supuestamente si es que está mal hecho, unos dos evaluadores en un plazo super acotado de tiempo, es irreal. Entonces el problema de fondo es finalmente que las consultoras no tienen los incentivos correctos como para poder realmente hacer un análisis de impacto, una evaluación de impacto y eso se se se lograría finalmente con que no hubiese una relación directa, sino que se licitarán los estudios'

"The problem is that it is the project owners [developers] *who pay the consultants and the incentive for both is that the project is approved as quickly as possible, and that it contains the fewest possible measures and identified impacts, and to reverse that logic is unrealistic. So, the basic problem is that consultancy firms do not have the right incentives to be able to really carry out an impact assessment, and this would finally*

be achieved by not having a direct relationship [with the developer]*, but by putting the studies out to tender"*

Specialist G2

Section 7.2.1

'Si tú aplicas la metodología, la metes en Excel y sale algo tan imposible de hacer como compensación, que entonces debiera automáticamente incentivar la aplicación de la jerarquía de mitigación y ese impacto debiera ser evitado'

"If you apply the methodology and come up with something as impossible to do as compensation, then it should automatically incentivise the application of the mitigation hierarchy and that impact should be avoided"

'Compensar tiene que ser caro, si no es caro, nunca va a haber un real incentivo para no hacer una compensación. Si sale barato compensar, obviamente lo van a hacer, pero sale barato porque son medidas mal diseñadas, mal evaluadas y que no tiene ninguna consecuencia si no se ejecutan, ninguna consecuencia verdadera'

"Compensation has to be expensive, if it is not expensive, there will never be a real incentive for not to compensate. If it is cheap to compensate, obviously they are going to do it, but it is cheap because they [compensation measures] *are poorly designed, and poorly assessed measures"*.

Section 7.2.2

'Lo que propone es que esto se vea en términos de hábitat y no de las fracciones, no la lagartija separada del pez, separada del árbol separada de la planta, sino que tú hagas una compensación protegiendo, recreando, generando adicionalidad en un hábitat'

"This has to be seen in terms of habitat and not in terms of fractions, not the lizard separated from the fish, separated from the tree, separated from the plant, but you compensate by protecting, recreating, generating additionality in a habitat".

Section 7.4.2

'Una es que el titular tenga realmente una consecuencia de que la medida no funcionó'

"The developer must actually have a consequence if the measure did not work"

'Cuando yo he visto miles de estudio impacto ambiental que dicen vamos a monitorear, monitorear por sí mismo es nada, el monitoreo tiene que tener una consecuencia'

"I have seen thousands of environmental impact studies that say we are going to monitor, monitoring by itself is nothing, monitoring needs to have a consequence"

Section 7.6.1

‘Porque ahí se levanta otro problema que es que los servicios están súper mal, la gente está mal pagada, son poco profesionales, tienen pocas capacidades, o sea tienen poco espacio para poder revisar medidas que no sean las que están acostumbrados a hacer… Están anclados en leyes super antiguas. un montón de criterios que ellos usan en leyes que están muy pasadas de moda, con capacidades muy restringidas y con presiones altísimas, entonces no tiene ningún ningún espacio, ningún incentivo, para poder aceptar otras medidas que son, por ejemplo, las que están en la nueva guía… pues de capacitar a los servicios, coordinar que las guías hablen el mismo idioma’

> *“The agencies are very bad, the people are poorly paid, they are unprofessional, they have little capacity, that is to say, they have little room to be able to check measures other than those they are used to check… They use laws that are very outdated, with very restricted capacities and very high pressures, so they have no incentive to accept other measures that are, for example, in the new national guide… agencies need to be trained and coordinated, a technical leap is needed for doing things better”.*

‘Pero yo creo que a grandes rasgos hay poca capacidad de ese evaluador, y esa poca capacidad tiene que ver con que es un evaluador mal pagado en un servicio con muy pocas capacidades, que además a él le sale mucho más fácil aprobar lo que se ha venido aprobando’

> *“I believe that the evaluator's capacity is low, and this low capacity has to do with the fact that he is a poorly paid evaluator in a Service with very few capacities, and it is much easier for him to approve what he has been approving”*

Section 7.6.2

‘El problema está en que los titulares que proponen estos estudios, que están súper torcidos en la manera que se proponent, el hecho de que el mismo titular pague consultores para que le haga el estudio, ya tiene un montón de vicios porque obviamente va a pagar para un estudio que tenga los menores impactos ambientales posible. En otros países los estudios no los hacen el mismo titular, no los paga, o sea, pone la plata, pero los servicios definen quién hace el estudio de manera que haya un menos conflicto de interés. lo segundo es que los estudios mismos son hechos con un foco de encontrar los menores impactos ambientales posibles, entonces omiten información, que sé yo, trucan información, y con consultoras, que además están súper entrenadas a proponer lo que siempre se aprueba y no a proponer medidas creativas’

> *“The problem is that the owners propose these studies* [developers]*, which are very twisted in the way they are proposed, the fact that the owner himself pays consultants to carry out the study, already has a lot of vices because obviously he is going to pay for a study that has identifies the least possible environmental impacts… the studies are done with a focus on finding the least possible environmental impacts, so they omit information, I don't know, they trick information, and with consultants, who are also super-trained to propose what is always approved and not to propose creative measures”*

NGO professional N

Section 7.4.2

‘Pero creo que me iría un poco más por establecer sanciones en caso de que la información que

corresponde que se entregue no se entregue'

> *"Sanctions should be aimed at establishing penalties in the event that the information that should be provided is not provided*

'La incorporación del principio precautorio, por ejemplo, también que se ha ido incorporando ya a través de distintas leyes, también puede ser un aporte'

> *"The incorporation of the precautionary principle, for example, which has already been incorporated through different laws, can also be a contribution"*

Section 7.5.1

'Y de hecho, otra cosa que también, no sé si podría ser de otra forma, pero quizás se podría perfeccionar es la forma, periodicidad y obligación de los reportes en un sistema integrado, etcétera, porque actualmente y que no, no veo que pueda ser de otra forma, al menos en corto, mediano plazo, el sistema se basa también en reportes de los titulares. Y bueno, cada cierto tiempo tiene que entregar esos reportes, pero claro, esos reportes los entregan los titulares, y también muchas veces la información que entregan no es fidedigna o como no es completa, al menos'

> *"Perhaps the form, periodicity and obligation of the monitoring reports could be improved in an integrated system, because the system is based on reports from the developers, and often the information they submit is not reliable or complete"*.

Section 7.6.1

'La solución, ahí es generar esa capacitación a los otros servicios de parte del servicio evaluación ambiental que quien emite la guía'

> *"The solution is the Environmental Assessment Service, which issues the national guides, should create this training for the agencies"*.

'Quizás hacer una evaluación a los evaluadores, como generar algún algún mecanismo de al menos para conocer cuál es el nivel de conocimiento o de interpretación, al menos sobre la sobre los temas principales, porque hay mucho que necesita interpretación legal de bueno con esto se cumple o no se cumple el requisito'

> *"Perhaps to assess the evaluators, to generate some mechanism to know what the level of knowledge or interpretation they have, at least on the main issues, because there is a lot that needs legal interpretation on whether or not the requirement is fulfilled"*.

'Bueno, lo primero para incentivar es educar, que se conozca, que se conozca y no quizás, no necesariamente, exclusivamente por las consultoras, que desde luego que tienen que conocerlo, pero también desde la ciudadanía, que son quienes eventualmente van a participar en los procesos, justamente de participación… Entonces en ese sentido, yo creo que la educación y el conocimiento y la difusión del contenido de esta guía es lo primero'

> *"The first thing to encourage is to educate, to make it known, and not perhaps exclusively by the consultants, who of course have to know about it, but also by the*

citizens, who are the ones who will eventually participate in the processes of citizen participation… In this sense, I believe that education and knowledge and dissemination of the contents of this guide is the first priority"

Section 7.6.2

'Todo el mundo sabe que las consultoras, claro, son independientes de las empresas titulares, pero están contratadas y que buscan por supuesto que el proyecto se está proponiendo se apruebe… pero el problema es justamente ese, como que el sistema de evaluación de impacto ambiental está hecho para aprobar proyectos, no para rechazarlos'

"Everyone knows that the consultants are independent of the developers, but they are contracted, and they are looking forward to the project being approved… So, the problem is precisely that, as the Environmental Impact Assessment System is designed to approve projects, not to reject them"

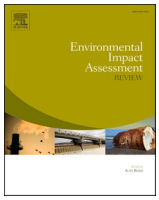
Appendix 10. Published paper included in the thesis.

Environmental Impact Assessment Review 102 (2023) 107214

Contents lists available at ScienceDirect

Environmental Impact Assessment Review

journal homepage: www.elsevier.com/locate/eiar



Investigating the implementation of the mitigation hierarchy approach in environmental impact assessment in relation to biodiversity impacts

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ARTICLE INFO

Keywords:
Mitigation hierarchy
Environmental impact assessment
Monitoring
Biodiversity outcome
No net loss biodiversity
Chile

ABSTRACT

Global loss of biodiversity has directly and indirectly been caused by human activities. Environmental Impact Assessment (EIA) attempts to address the loss of biodiversity caused by development projects, by avoiding, reducing or compensating the loss (in that order following the mitigation hierarchy approach). Evidence suggests that in practice the mitigation hierarchy is not always applied correctly, and that monitoring is frequently absent, or flawed, meaning that the success of the mitigation measures, and their associated biodiversity outcomes, remain unknown. However, there is no literature that has systematically examined the application of the mitigation hierarchy and assessed the effectiveness of associated monitoring in an EIA system. This study fills that gap using Chile as an example because of its high biodiversity setting, and ease of access to EIA-related data. The results indicate that the use of compensation measures exceeded what would be expected from correct implementation of the mitigation hierarchy, and that there was also some misclassification of the measures. Monitoring studies focused on inspecting implementation of mitigation measures rather than measuring biodiversity outcomes (meaning that mitigation effectiveness cannot be fully evaluated). Further, there was a focus on specific elements of ecosystems and lack of consideration for broader biodiversity implications. Thus, the findings raise some concerns over the ability of EIA to achieve its goals of zero net loss of biodiversity. We make suggestions to improve the mitigation and monitoring aspects of the EIA process in Chile and would suggest that the recommendations are likely to have wider relevance to other jurisdictions.

1. Introduction

Anthropogenic threats are mostly acting as drivers of biodiversity change in many environments across the Earth (Bowler et al., 2020). The rapid growth and expansion of the human populations (McKee et al., 2004) and increase in extraction of natural resources and primary productivity (Wackernagel et al., 2021) has become one of the greatest threats to species biodiversity and ecosystem function, producing habitat loss and, consequently, biodiversity loss (Duffy, 2003; Balmford and Bond, 2005; Cardinale et al., 2012). A diverse range of conservation instruments has been applied to protect biodiversity (Tilman et al., 2017) and reduce pressure from infrastructure development (Laurance et al., 2015). Despite these efforts, the latest Intergovernmental Panel on Climate Change (IPCC) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) reports indicate that the unsustainable use of natural resources derived from anthropogenic activities continues (IPBES, 2019; IPCC, 2022).

Several national and international policy instruments (e.g., article 14 of the Convention on Biological Diversity (CBD)) propose the application of environmental impact assessment (EIA) as a crucial instrument for minimizing biodiversity loss (Slootweg and Kolhoff, 2003). All projects that are likely to have significant adverse effects on biological diversity should use these instruments to avoid or minimise negative biodiversity impacts (CBD, 1992). Chile is one of the signatories of the CBD and implemented environmental legislation in 1994 to meet its CBD obligations, including a requirement for Environment Impact Assessment (EIA). From 2014, EIA in Chile has included a requirement for biodiversity compensation for all the significant impacts that cannot be mitigated or repaired (excluding impacts of low significance), known as 'appropriate compensation of biodiversity' in Chile (SEA, 2014), but better known globally as 'Biodiversity Offsets' (BBOP, 2009, 2012). The goal of Biodiversity Offsetting is to achieve at least zero net loss of biodiversity by implementing actions designed to compensate for losses resulting from development projects.

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https://doi.org/10.1016/j.eiar.2023.107214
Received 25 May 2023; Received in revised form 11 July 2023; Accepted 13 July 2023

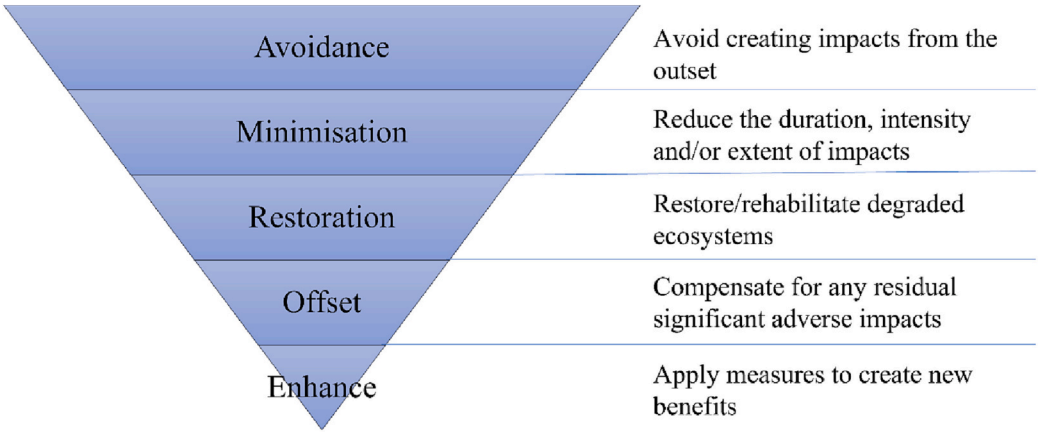

Fig. 1. The mitigation hierarchy (adapted from Glasson and Therivel, 2019).

EIA as a generic process (specific requirements in individual jurisdictions may differ) involves an assessment of the impacts of a proposed development, including the identification of mitigation measures to address potentially significant impacts, and subsequent monitoring to determine the environmental outcomes (Glasson and Therivel, 2019). Biodiversity protection through EIA involves the implementation of the mitigation hierarchy in order to address the environmental impacts of a development project, focussing on avoidance at first, followed by minimisation and reduction as the subsequent steps, and considering offsetting (compensation) as a last resort (BBOP, 2009, 2012; CEQ, 2020; Tucker et al., 2020). Glasson and Therivel (2019) also refer to the inclusion of measures in EIA to create environmental benefits beyond pure mitigation of impacts (enhancement), which can help to highlight the opportunities for the EIA process to deliver benefits as well as controlling negative impacts only (Fig. 1). The correct implementation of the mitigation hierarchy is argued to be better (than incorrect implementation) for biodiversity, reducing the need for short-term restoration and offsetting, and preventing the need to deal with subsequent problems such as long-term restoration, uncertainty over the effectiveness of any offsets, the cost of the monitoring for the duration of the offsets, as well as negative social impacts (Maron et al., 2016; Lindenmayer et al., 2017; Phalan et al., 2018).

The success of the implementation of the mitigation hierarchy relies on the execution of post-decision monitoring to verify the effectiveness of the mitigation measures (Sánchez and Gallardo, 2005; Drayson and Thompson, 2013; Morrison-Saunders et al., 2021). Monitoring in the environmental assessment context is defined as the collection of data after the implementation of the activity to evaluate the environmental performance of a project or plan (Morrison-Saunders et al., 2007). Monitoring involves the measuring of environmental variables and parameters of interest over a period of time, in order to obtain information on the general state of the environment (Arts et al., 2001). To be more effective, monitoring should evaluate those parameters more susceptible to, and expected to be affected by, changes in the environmental conditions, facilitating the reduction of uncertainty associated with the predictions (Glasson, 1994).

As the central objective of the mitigation hierarchy is to at least reach ecological equivalence between biodiversity losses caused by the impacts of a development project and the gains produced by offsetting (Gelot and Bigard, 2021; Boileau et al., 2022), EIA-related biodiversity monitoring is essential to determine the effectiveness of the measures implemented to minimise the impacts on biodiversity resulting from development activities (Bataineh, 2007; Pickett et al., 2013). Once the measures have been implemented, in terms of them being carried out appropriately, the effectiveness of the measures verifies whether they have delivered the intended biodiversity outcome (Drayson and Thompson, 2013). In this regard, biodiversity monitoring programs should focus both on the process and the outcomes to establish whether the results of the process met the expected purposes (Chanchitpricha and Bond, 2013). Also, verifying biodiversity outcomes is needed to provide a feedback loop to increase the effectiveness of mitigation measures and effectively contribute to minimizing development impacts on biodiversity (Quétier and Lavorel, 2011; Gelot and Bigard, 2021).

Despite this, several weaknesses in the implementation of the mitigation hierarchy have been described in the literature, including the failure to follow the hierarchy sequence and the lack of monitoring to evaluate their effectiveness (Bull et al., 2016; Maron et al., 2016; Bigard et al., 2017; Lindenmayer et al., 2017; Phalan et al., 2018). For instance, although impact avoidance has been described in the literature as the most important step in the mitigation hierarchy (Ekstrom et al., 2015; Gelot and Bigard, 2021), in practice it is often ignored, misunderstood, and poorly applied (Phalan et al., 2018), partly because there is no specific guidance on how to classify certain impacts within the mitigation hierarchy, or clear indications on when to move from one level to another (Bull et al., 2016; Maron et al., 2016; Bigard et al., 2017). According to Bigard et al. (2017), only the total absence of environmental impacts in the area of the project by the change or reduction of the perimeter of the project would be considered as avoidance, therefore other types of activities should be considered as minimisation at best. Bigard et al. (2017) refers to a semantic confusion in the definitions of each type of measure, leading to some measures being incorrectly proposed in terms of their place in the mitigation hierarchy. This is also identified by Bull et al. (2016), indicating that multiple terms in the literature refer to the same level of the mitigation hierarchy, creating a conceptual challenge in its application. Additionally, monitoring is failing to demonstrate achievement of biodiversity outcomes (Lindenmayer et al., 2012; Lindenmayer et al., 2017). The quality and level of the post-decision monitoring has been criticized as being insufficient to ensure the successful implementation of the measures, mainly because of the lack of human and financial resources for the long-term monitoring programmes (Pickett et al., 2013; Gelot and Bigard, 2021).

It should be noted that the term compensation is usually used for economic compensation and the term offset is used for biodiversity compensation (Alonso et al., 2020). However, in Spanish, the term

Table 1
The mitigation hierarchy and the equivalent terms used in Chile.

Mitigation hierarchy (after Glasson and Therivel, 2019)	Equivalent terms in Chile (SEA, 2014)
Avoid	Mitigation
Minimise	Mitigation
Restore	Repair
Offset	Compensation
Enhance	[No equivalent]

compensation is used for both situations, which can cause confusion and, in some cases, can lead to compensation being carried out for aspects not necessarily related to biodiversity, therefore failing to meet the aim of offsetting biodiversity loss (Alonso et al., 2020). In Chile, the term biodiversity compensation is used to refer to biodiversity offsetting (Bull et al., 2016), therefore it will be the term used in this research. Also in Chile, the mitigation hierarchy is called the 'hierarchy of measures', and the terms used differ somewhat from the terms outlined in Fig. 1 as set out in Table 1.

There is no literature that focuses on the application of both the mitigation hierarchy and associated monitoring in a single jurisdiction's EIA system. Such research has the potential to identify specific opportunities for improving practice and, therefore, biodiversity outcomes. This paper aims to investigate the implementation of the mitigation hierarchy in Chile, a country that recently implemented biodiversity offsetting in its national environmental legislation. Therefore, the overall aim is to evaluate the extent to which biodiversity is being protected by the Chilean environmental legislation in practice, specifically through the application of the mitigation hierarchy. Based on this, the following research questions are asked: Is the mitigation hierarchy being followed? Is the monitoring of the measures implemented effective?

The paper is structured as follows. The next section introduces an outline of the current state of biodiversity in Chile and presents the relevant institutional framework (section 2). Section 3 introduces EIA in Chile and sets out the mitigation requirements. Section 4 introduces the reporting process in Chile and associated databases and explains the case study selection. Sections 5 and 6 examine the two research questions in turn, introducing the methods, results, and key findings. Finally, conclusions and recommendations are presented in section 7.

2. Biodiversity in Chile and the Chilean conservation framework

The biodiversity of Chile is known for its high degree of endemism and the exclusivity of some of its ecosystems, caused by the biogeographic conditions (MMA, 2019). Chile presents multiple types of ecosystems (terrestrial, marine, coastal and oceanic islands), which are critical to the economic development and social well-being of the population, and which fulfil crucial functions for maintaining key ecosystem services (Lara et al., 2009). Chile has one of the five Mediterranean-climate regions known in the world (McNally, 1990); is characterised by a high endemicity of plants and animals in the Juan Fernández Archipelago (Ormazabal, 1993); and hosts the Chilean Winter Rainfall-Valdivian Forest which is considered to be one of the 35 global biodiversity hotspots (Mittermeier et al., 2011). Also, it was recently found to possess 88 out of 110 global ecosystems existing on the planet (Keith et al., 2022).

The main pressures on terrestrial ecosystems in Chile are degradation and fragmentation due to human activities, such as changes in the use of land including forest reduction and conversion of shrubland to cultivated land, illegal logging of forests, and the creation of plantations with exotic species (Armesto and Arroyo, 1991; Lara et al., 2009; MMA, 2019). Negative impacts on biodiversity in Chile have been associated with agricultural and forestry industry, urbanisation, and mining, which produce the main pressures on fragile ecosystems through the clearing of native forests, the establishment of pastures and crops, the extraction of groundwater, and the contamination of aquifers (MMA, 2019).

Chile has adhered to numerous international treaties related to the conservation of its natural heritage, such as the Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere (1940), Ramsar Convention (1971), CITES (1973), and CBD (1992), among others (PNUD, 2017). Additionally, in 2003, Chile implemented its National Biodiversity Strategy, which was updated in 2017 and currently runs from 2017 to 2030. The National Biodiversity Strategy is the instrument of public policy integrating the main strategic objectives, actions and goals of the country in terms of conservation and sustainable use of biodiversity (MMA, 2018). Furthermore, Chile agreed 20 targets (known as the 2010 Aichi biodiversity targets) aimed at reducing the loss of biological diversity at the global level, integrated in the National Biodiversity Strategy (MMA, 2018).

In order to administer the increasing number of biodiversity protection commitments, Chile is creating the *Servicio de Biodiversidad y Áreas Protegidas* (Biodiversity and Protected Areas Service). However, this Service is currently in the legislative process (Sierralta et al., 2011; MMA, 2018) and one of the main challenges Chile must address in biodiversity protection is the completion and consolidation of the current environmental institution framework.

3. The EIA system and mitigation requirements in Chile

In 2010, Law N°20,417 modified Law N°19,300 on *Bases Generales del Medio Ambiente* (General Environmental Bases), creating the *Ministerio de Medio Ambiente* (Ministry of Environment), the *Servicio de Evaluación Ambiental* (Environmental Assessment Service), and the *Superintendencia de Medio Ambiente* (Superintendency of the Environment). The Environmental assessment service manages and implements the Environmental Impact Assessment System (EIAS) in Chile (MINSEGPRES, 2010) which includes oversight of impact assessment; mitigation, repair, and compensation planning, and monitoring planning. The Superintendency of the Environment executes, organizes, and coordinates the follow-up and monitoring. Furthermore, from 2014, the projects submitted to the EIAS must be responsible for the environmental impact and loss of biodiversity caused by the execution of the project, since the *Guía para la compensación de biodiversidad en el SEIA* (Guide for the compensation of biodiversity in the EIAS, henceforth referred to as the national guideline) was published.

The national guideline details the minimum essential elements required for appropriate compensation for biodiversity loss, which requires the significant adverse effects identified in the Environmental Impact Study (EIS) to be balanced by the positive effect, promoting a zero net loss of biodiversity as a result of the implementation of projects or activities, or even a net gain (SEA, 2014). The EIS is the single document that provides well-founded background information for the prediction and identification of the environmental impacts (MMA, 2012; Rodríguez-Luna et al., 2021). All the EISs that identify significant impacts as a result of the impact assessment, have the obligation to present a plan with measures to mitigate, repair, or compensate the impacts, and also a monitoring plan. The national guideline is legally binding for the EIAS and points out the principle of the hierarchy of measures (mitigation hierarchy) as the mainstay in the appropriate compensation of biodiversity (Menchaca and Ravera, 2019). The mitigation hierarchy is defined in the national guideline as the sequential application of measures to reduce the potential negative impacts of development projects on biodiversity: (i) mitigation (which includes avoidance and minimisation, the first two steps in international literature); (ii) repair (corresponding to rehabilitation/restoration); and (iii) compensation (referred to as offsets). Mitigation and repair should be prioritised over compensation, in order to prevent biodiversity loss (SEA, 2014). The national guideline was updated in 2022 (SEA, 2022a) to introduce the *Guía metodológica para la compensación de biodiversidad en ecosistemas terrestres y acuáticos continentales* (Methodological guide for the compensation of biodiversity in continental terrestrial and aquatic ecosystems), which aims to deliver a clear and detailed methodology to quantify the biodiversity losses in terrestrial and aquatic ecosystems in projects or activities submitted to the EIAS (SEA, 2022b).

In Chile, the monitoring planning is established in the EIS, indicating the form and location of implementation, details of the measure that will be monitored, the component of biodiversity affected, timing, and the indicator that will be monitored, corresponding to the target to be measured to verify the success of the measure. Monitoring in Chile is mandatory for all the projects which have declared significant impacts, and the duration of the monitoring is stated to be for the lifetime of the

Table 2
Criteria for the selection of EISs for review.

Criterion	Restriction	Potential implication to the practice
Productive sector	Any	Criteria relating to productive sector and region were applied to ensure the final selection was representative enough of the overall cases where environmental impact studies are required in Chile (Wood and Jones, 1997).
Geographical area (region)	Any	The projects are assessed by different authorities depending in which region they are being submitted to the EIAS (Wood and Jones, 1997).
Planning decision	Permission granted	The sample only included approved EISs where the planning permission was already granted by the authority because these projects would generate monitoring requirements which are the focus of the third question.
Biodiversity compensation required	From 2015	EISs were searched from 2015 onwards to ensure that the recommendations of the national guideline (SEA, 2014) on biodiversity compensation had been incorporated or requested by the authority.

project or an equivalent time, which is decided by the relevant authority before the permission is granted. The monitoring reports in Chile are required for all the stages of the project (construction, operation, and decommissioning). The proponents should periodically submit monitoring reports to the *Superintendencia de Medio Ambiente* (Superintendency of the Environment), in charge of the post-evaluation process, which can perform audits to verify the accuracy of the monitoring programs, imposing sanctions or fines if the conditions according to what was established in the EIS are not being fulfilled (MINSEGPRES, 1994; MMA, 2012).

4. Selection of the EISs

EIS selection was constrained by the need to obtain a sample large enough to statistically represent practice yet excluding a sufficient number of EISs to make the analysis practical and focused on biodiversity impacts. This involved developing criteria known to influence the content of EISs (Wood and Jones, 1997), with a focus on biodiversity content. A representative sample of 31 EISs was selected using the criteria presented in Table 2.

All submitted EISs are available on the public online database of the Environmental Assessment Service (https://www.sea.gob.cl/) which is the authority in charge of assessing the EISs.

The 31 EISs selected represent sectors that have impacts on biodiversity components, which are identified as those affecting fauna, flora, vegetation, aquatic ecosystems, terrestrial ecosystems, and priority sites. Also, they correspond to those that have monitoring data available for the proposed mitigation, repair and compensation measures related to some of the components of biodiversity affected (for the remaining projects, monitoring has not yet started, or data are not yet available) (Fig. 2). The monitoring data are available in the public online database of the Superintendency of the Environment (https://snifa.sma.gob.cl/SeguimientoAmbiental/RCA), the authority in charge of monitoring and follow up.

The 31 EISs included cover six sectors, with 17 EISs corresponding to 'energy' projects, followed by eight from 'mining', two from 'hydraulic', two from 'others', one from 'housing' and one from 'sanitation' (according to the categories indicated by the Environmental Assessment Service). These cases are located all over the country, 12 in the north zone, 10 in the centre zone, three in the south zone, with a further six being interregional projects (Fig. 3).

The 31 EISs included in this study were considered representative of the type of biodiversity impacts produced by investment projects in Chile (Table 3). Consequently, the results and conclusions can be extrapolated to represent Chilean practice.

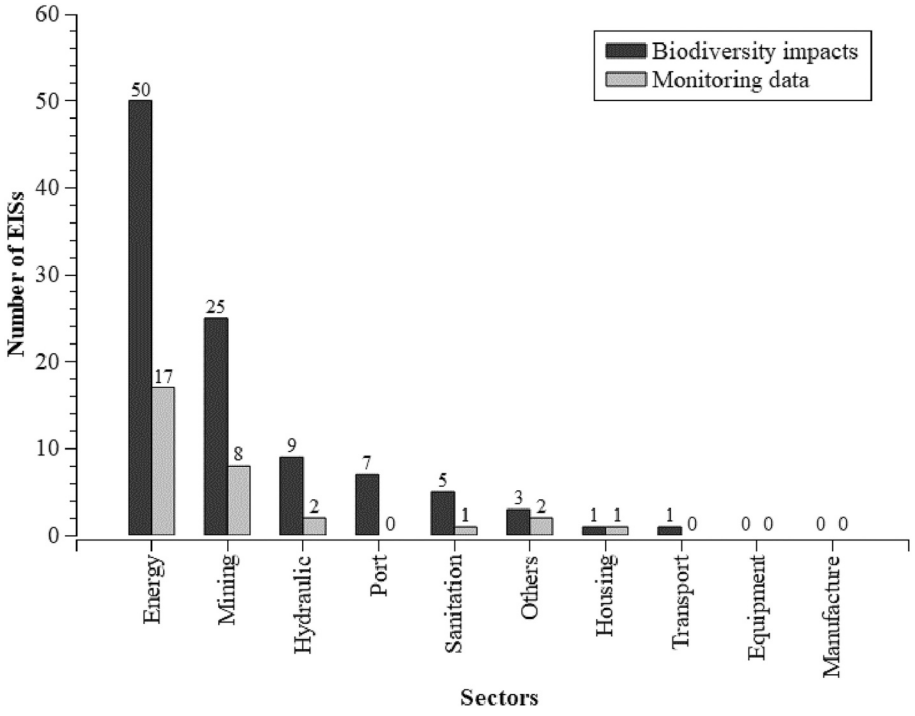

Fig. 2. Number of EISs approved between 2015 and 2022 reporting biodiversity impacts per sector. The total number of EISs in each sector is indicated in black, of which the EISs with monitoring data available are represented in grey (as of March 9, 2022).

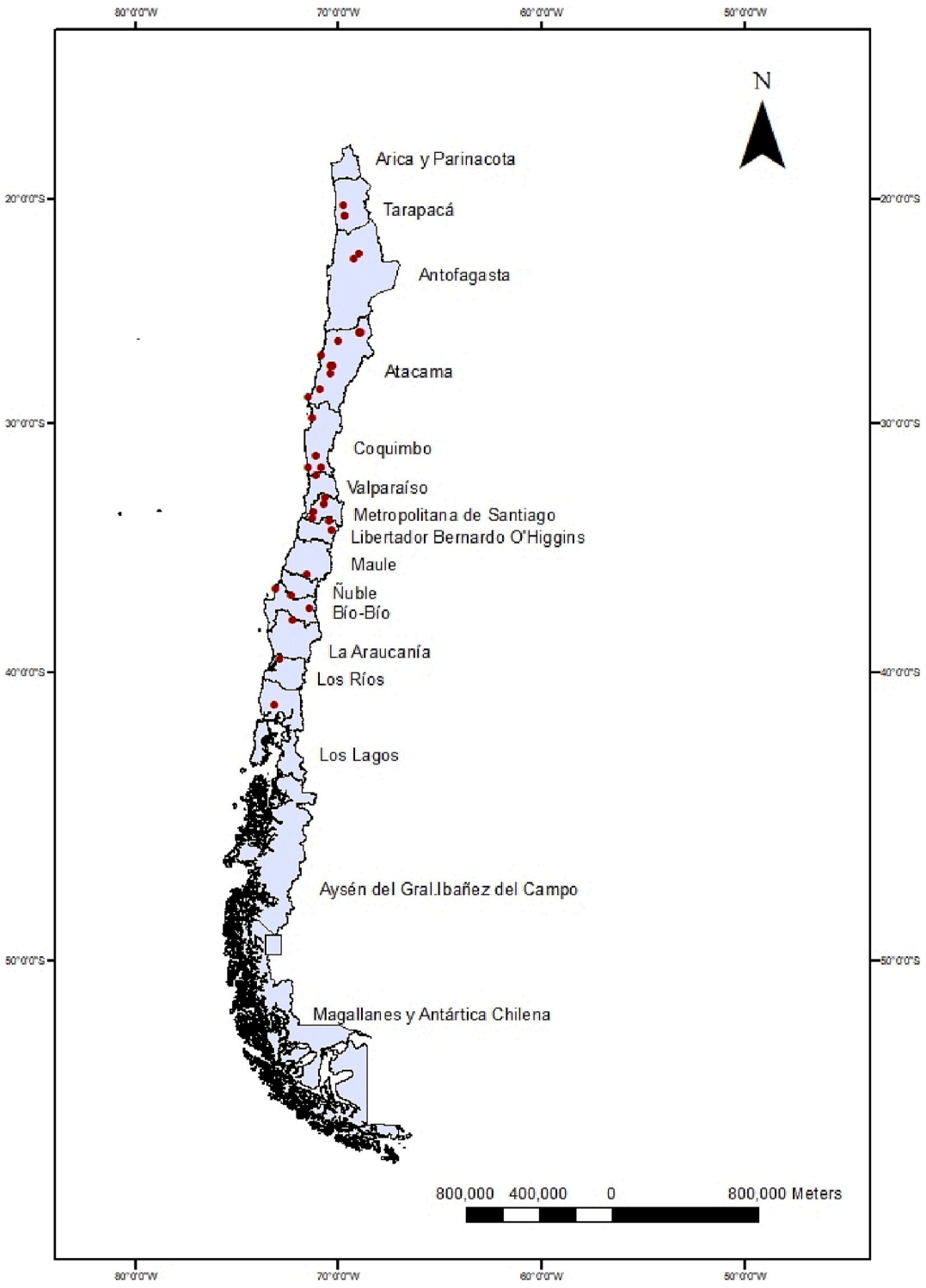

Fig. 3. Map of Chile and location of the 31 projects reviewed in this study (red dots). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

5. Is the mitigation hierarchy being followed?

5.1. Methods

Following the defined mitigation hierarchy in this paper, based on the Chilean EIA System, the mitigation, repair, and compensation measures proposed by the proponents to address biodiversity impacts were reviewed in each of the 31 EISs studied. The number of measures at each level of the mitigation hierarchy (mitigation, repair, and compensation) was counted to analyse the use of the mitigation hierarchy by each development project. To investigate if the measures had been correctly allocated to the right category of the mitigation hierarchy, all the activities involved in each measure proposed were checked and occasionally reclassified by the researchers following the definitions of the national guideline (SEA, 2014) and from the specific National Services with environmental competence in charge of reviewing the

Table 3
EISs selected by sector, region and approval date.

Name of the project	Sector	Region	Approval Date	Measures*			Monitoring*		
				M	R	C	M	R	C
Proyecto Nueva Línea 2 × 500 kv Charrúa-Ancoa: tendido del primer conductor	Energy	Interregional	30-Jan-2015	9	1	3	9	–	2
Línea 2 × 220 kV Ciruelos-Pichirropulli	Energy	Los Ríos	14-Apr-2015	14	1	2	6	–	–
Explotación Minera Oso Negro	Mining	Atacama	18-Jun-2015	7	–	3	2	–	2
Proyecto Parque Solar Quilapilún	Energy	Santiago	24-Jun-2015	–	–	4	–	–	4
Proyecto Santo Domingo	Mining	Atacama	8-Jul-2015	3	–	4	1	–	2
Candelaria 2030 - Continuidad Operacional	Mining	Atacama	28-Jul-2015	2	–	5	1	–	1
Proyecto Parque Eólico Aurora	Energy	Los Lagos	25-Sep-2015	5	–	–	1	–	–
Plan de Expansión Chile LT 2 × 500 kV Cardones – Polpaico	Energy	Interregional	11-Dec-2015	8	–	4	7	–	1
Proyecto El Espino	Mining	Coquimbo	12-Jan-2016	2	–	3	–	–	3
Mini Central Hidroeléctrica de Pasada Cipresillos	Energy	Rancagua	9-Feb-2016	2	–	2	1	–	1
Nueva Línea 2 × 220 kV Encuentro-Lagunas	Energy	Interregional	8-Mar-2016	7	–	1	4	–	–
Ampliación y Modernización Planta Enaex S.A. La Serena	Others	Coquimbo	9-May-2016	8	–	1	2	–	–
Parque Fotovoltaico Santiago Solar	Energy	Santiago	4-Jul-2016	2	–	1	2	–	1
Planta Desalinizadora de Agua de Mar para la Región de Atacama, Provincias de Copiapó y Chañaral	Sanitation	Atacama	19-Aug-2016	8	3	1	1	1	–
Parque Eólico Malleco	Energy	Araucanía	24-Nov-2016	3	–	–	1	–	–
Embalse de Regadío Las Palmas	Hydraulic	Valparaíso	19-Dec-2016	8	–	1	2	–	–
Proyecto Hidroeléctrico Embalse Digua	Energy	Maule	24-Apr-2017	2	1	1	2	–	–
Minicentrales Hidroeléctricas de pasada Aillín y Las Juntas	Energy	Biobío	4-May-2017	9	1	6	4	1	1
Minerales primarios Minera Spence	Mining	Antofagasta	4-Aug-2017	1	–	–	1	–	–
Infraestructura Complementaria	Mining	Coquimbo	14-Feb-2018	4	1	2	2	–	2
Proyecto mejoramiento de la generación, transporte y disposición de residuos arsenicales de división el teniente	Mining	Rancagua	8-Jun-2018	3	–	–	1	–	–
Planta Fotovoltaica Santa Rosa	Energy	Santiago	24-Sep-2018	–	–	3	–	–	2
Parque Eólico Cabo Leones III	Energy	Atacama	17-Dec-2018	2	–	1	2	–	1
Concesión Vial Puente Industrial	Hydraulic	Biobío	17-Dec-2018	3	–	3	3	–	–
Mirador de Lo Campino	Housing	Santiago	19-Dec-2018	4	–	–	2	–	–
Línea de Transmisión Lo Aguirre - Alto Melipilla y Alto Melipilla – Rapel	Energy	Interregional	21-Dec-2018	9	–	7	5	–	1
Nuevas Líneas 2 × 220 kV entre Parinacota y Cóndores	Energy	Interregional	29-Nov-2019	2	–	1	2	–	–
Estudio de Impacto Ambiental Proyecto Salares Norte	Mining	Atacama	18-Dec-2019	1	–	3	1	–	2
Estudio Impacto Ambiental Circunvalación Oriente Calama	Others	Antofagasta	17-Sep-2020	4	–	1	2	–	–
Nueva Línea Nueva Maitencillo -Punta Colorada -Nueva Pan de Azúcar 2 × 220 kV, 2 × 500 MVA	Energy	Interregional	17-Nov-2020	5	3	–	4	–	–
Nueva Línea Transmisión 2 × 220 kV Nueva Pan de Azúcar-Punta Sierra-Centella	Energy	Coquimbo	29-Mar-2021	3	–	1	1	–	–

* Letters in Measures and Monitoring correspond to: M = mitigation, R = repair, C = compensation. Numbers represent the total number of measures of each category proposed in the EIS, and the number of measures with available monitoring data (as of March 9, 2022).

Table 4
Number of measures proposed by sector.

Measure/Sector	Energy	Mining	Hydraulic	Sanitation	Housing	Others	Total
Mitigation	82	23	11	8	4	12	140
Repair	7	1	0	3	0	0	11
Compensation	37	20	4	1	0	2	64
Total	126	44	15	12	4	14	215

impacts related to biodiversity in the EISs (i.e., the *Corporación Nacional Forestal* (National Forest Corporation) (CONAF, 2020), and the *Servicio Agrícola y Ganadero* (Agricultural and Livestock Service) (SAG, 2016, 2021)).

5.2. Results and discussion

For the 31 EISs analysed in this study, a total of 215 measures were proposed at the various levels of the mitigation hierarchy: mitigation (140), repair (11), and compensation (64). The number of measures proposed for the projects in each sector is presented in Table 4. When the number of measures are compared to fit in the model of mitigation hierarchy proposed by the national guidelines (SEA, 2014), which is a simplification of that presented in Fig. 1 including mitigation, repair and compensation, it is found that most of the identified measures are aimed at mitigating impacts, followed by measures aimed at compensating for impacts. This contradicts expectations according to the mitigation hierarchy, as there is a tendency to use more compensation than repair measures.

Analysing the distribution of the measures in the mitigation hierarchy by project, considering the 31 EISs reviewed, it was observed that 12 projects proposed all stages of the hierarchy: mitigation, repair, and compensation measures (when it was necessary). The majority of the projects (17) however, did not propose any repair measures, whilst a few projects (2) only proposed compensation for all the impacts, confirming the tendency to propose fewer repair measures than expected based on the national guidelines.

The specific activities proposed as mitigation, repair, and compensation measures were extracted from the EISs, and categorised by type of activity as shown in Fig. 4a. Out of 19 categories established, seven had multiple classifications across the EISs. For example, rescue and relocation of fauna was considered to be mitigation in some EISs but also to be compensation in others; and rescue and relocation of plants was categorised differently as mitigation, repair, and compensation. Therefore, the activities described in the EISs were examined in depth, reviewing the content of each planned measure, to determine whether these inconsistencies corresponded to a contextual situation or if some misclassification could be detected.

The multiple classifications disappear after the reclassification (Fig. 4b). Activities related to environmental training, studies, and economic financing were classified as accompanying measures (see next paragraph). Overall, it was found that 178 out of 215 measures correctly

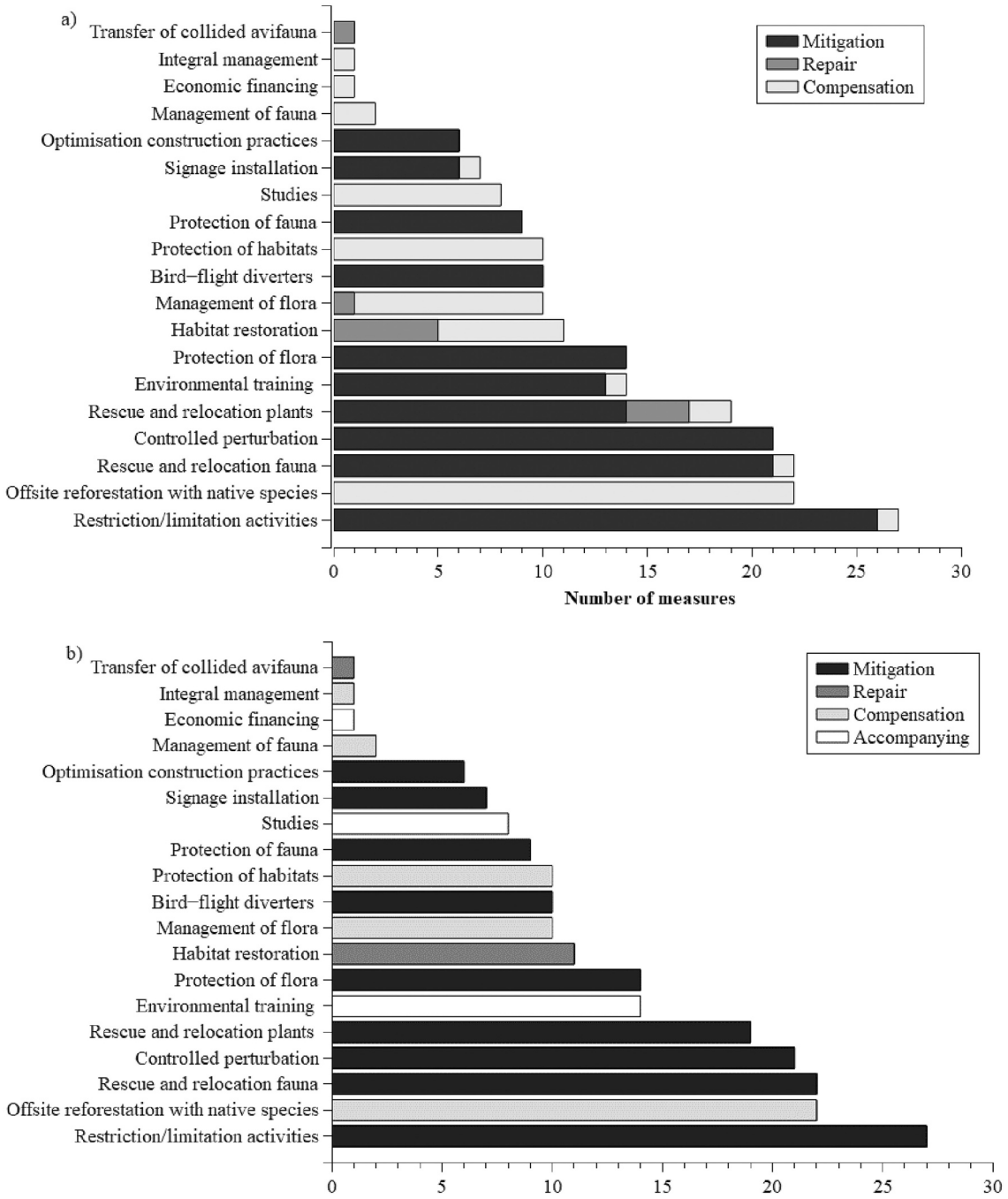

Fig. 4. Number of specific types of mitigation, repair, and compensation measures reported in the 31 EISs selected (a) and once they were reclassified (b).

followed the mitigation hierarchy classification indicated in the national guidelines for each category (SEA, 2014; SEA, 2022a) representing 83% of the total proposed measures. Thus, 37 measures were initially misclassified (17%) (Fig. 5).

In the re-evaluation of the measures, those that "*improve the effectiveness of offset measures or to additionally safeguard their environmental success*" (Jacob et al., 2016, p. 84), such as knowledge acquisition, socioeconomic activities, awareness-raising measures, among others (Jacob et al., 2016) were classified as accompanying measures in this study as they have no tangible or measurable biodiversity outcome. They represented 11% of the total number of measures proposed. They also included measures related to "staff environmental training" and "workers training talks", for which CONAF indicates that "*training talks for staff on flora and vegetation will not be considered as a mitigation measure*" (CONAF, 2020, p. 40).

The reclassification also allowed mitigation measures to be separated into avoidance and minimisation by the researchers, which are otherwise combined in the category of 'mitigation' within the EIS (according to the national guideline). This allows a clearer examination of the use of the mitigation hierarchy. In this regard, most of the re-classified measures proposed for mitigation were minimisation (121 being 56% of the total of 215 measures) rather than avoidance (14 measures corresponding to 7% of the total of 215 measures) (Fig. 6). Bigard et al. (2017) found that reduction or minimisation of impacts is by far the most common measure proposed in practice for biodiversity, which is consistent with the results of this study, where most of the measures proposed within the EISs corresponded to restriction or limitation of activities, rescue and relocation of species and controlled perturbation,

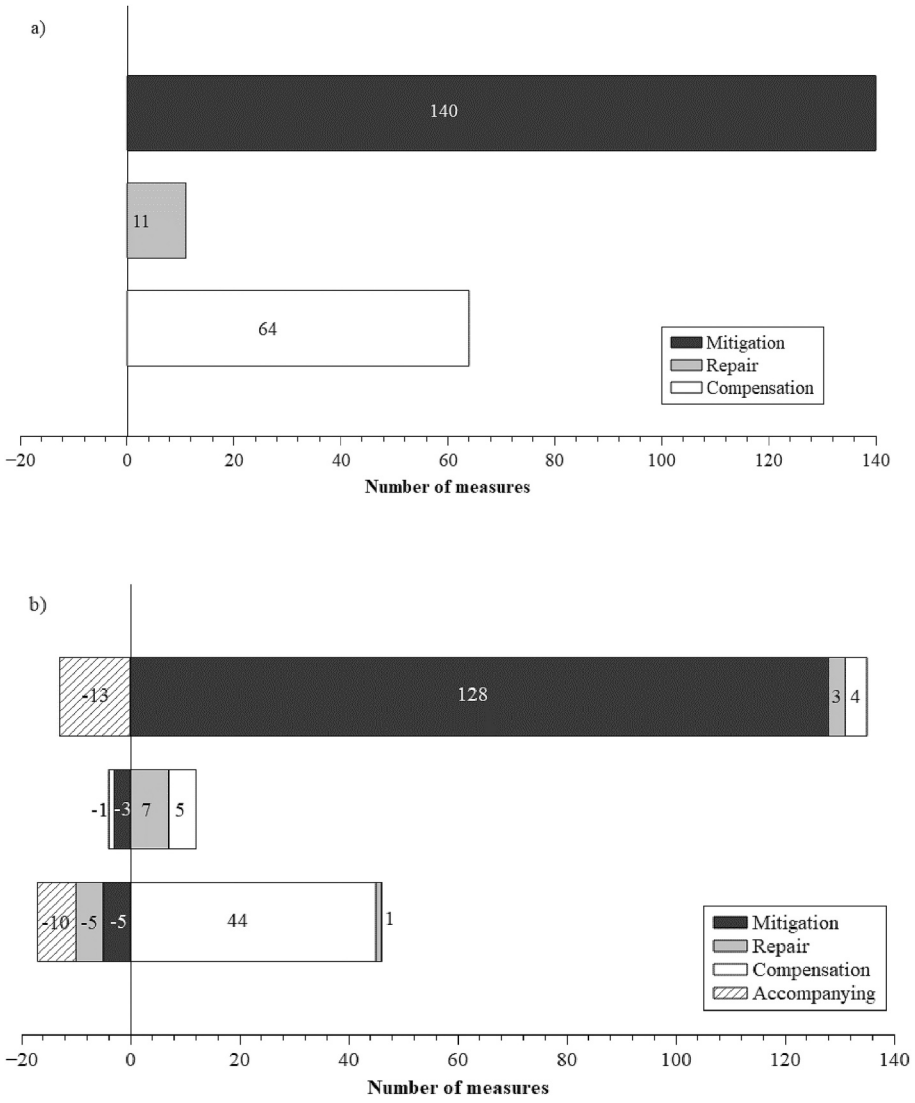

Fig. 5. Total of proposed measures (215 in the 31 EISs) for each category (a) and once they were re-evaluated following the national guidelines (b).

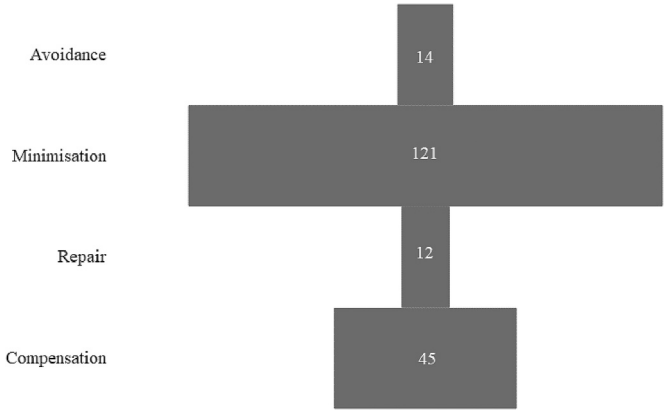

Fig. 6. Representation of the mitigation hierarchy found in this study.

which would often be aimed at minimizing impacts, especially in the construction phase. Avoiding impacts on biodiversity is rarely proposed as the first alternative in the mitigation hierarchy (Bigard et al., 2017; Phalan et al., 2018; Larsen et al., 2018). In this study, the 14 avoidance measures were proposed by energy, hydraulic, and 'others' projects, whereas for mining projects, avoidance measures such as reducing the affected area or changing the location area do not seem viable alternatives due to the nature of the project. Although more emphasis is placed in the literature on the avoidance stage of the mitigation hierarchy (Ekstrom et al., 2015; Maron et al., 2016; Phalan et al., 2018), the context for the project in terms of location, sector, and the nature of the impact, all seem to influence the extent to which this is realistic.

The same arguments apply to repair measures; as shown in Fig. 6, repair measures were the least proposed, even though the national guidelines prioritise repair over compensation (SEA, 2014). Repair measures are designed to replace or restore the basic properties of one or more components to a quality similar to that which they had before the impact (MMA, 2012; SEA, 2014), implying that the repair must be done in the place where the impacts occur. However, in practice, it is not always possible to repair the impacts due to the biodiversity loss that occurs through replacement with infrastructure, which leads inevitably to compensation (offsetting) as the next viable step. In this study, none of the mining projects proposed avoid or repair measures, mostly because it is difficult to recover biodiversity in the place where it has been affected, due to the construction and operation of the project.

Finally, 45 measures were in fact compensation measures, most of them being reforestation, management of flora and protection of habitats. By examining the sequence of the mitigation hierarchy, it was

Table 5
Number of monitoring reports required, available and completed by project to date (as of March 9, 2022).

Project	Approval	Required	Available	Completed	Progress
	Year	$n = 215$	$n = 100$	$n = 73$	%*
Proyecto Nueva Línea 2 × 500 kv Charrúa-Ancoa: tendido del primer conductor	2015	13	11	8	62
Línea 2 × 220 kV Ciruelos-Pichirropulli	2015	17	6	6	35
Explotación Minera Oso Negro	2015	10	4	4	40
Proyecto Parque Solar Quilapilún	2015	4	4	2	50
Proyecto Santo Domingo	2015	7	3	3	43
Candelaria 2030 - Continuidad Operacional	2015	7	2	2	29
Proyecto Parque Eólico Aurora	2015	5	1	0	0
Plan de Expansión Chile LT 2 × 500 kV Cardones – Polpaico	2015	12	8	8	67
Proyecto El Espino	2016	5	3	0	0
Mini Central Hidroeléctrica de Pasada Cipresillos	2016	4	2	0	0
Nueva Línea 2 × 220 kV Encuentro-Lagunas	2016	8	4	4	50
Ampliación y Modernización Planta Enaex S.A. La Serena	2016	9	2	2	22
Parque Fotovoltaico Santiago Solar	2016	3	3	2	67
Planta Desalinizadora de Agua de Mar para la Región de Atacama, Provincias de Copiapó y Chañaral	2016	12	2	2	17
Parque Eólico Malleco	2016	3	1	1	33
Embalse de Regadío Las Palmas	2016	9	2	2	22
Proyecto Hidroeléctrico Embalse Digua	2017	4	2	2	50
Minicentrales Hidroeléctricas de pasada Aillín y Las Juntas	2017	16	6	3	19
Minerales primarios Minera Spence	2017	1	1	1	100
Infraestructura Complementaria	2018	7	4	2	29
Proyecto mejoramiento de la generación, transporte y disposición de residuos arsenicales de división el teniente	2018	3	1	1	33
Planta Fotovoltaica Santa Rosa	2018	3	2	0	0
Parque Eólico Cabo Leones III	2018	3	3	2	67
Concesión Vial Puente Industrial	2018	6	3	3	50
Mirador de Lo Campino	2018	4	2	0	0
Línea de Transmisión Lo Aguirre - Alto Melipilla y Alto Melipilla – Rapel	2018	16	6	4	25
Nuevas Líneas 2 × 220 kV entre Parinacota y Cóndores	2019	3	2	2	67
Estudio de Impacto Ambiental Proyecto Salares Norte	2019	4	3	1	25
Estudio Impacto Ambiental Circunvalación Oriente Calama	2020	5	2	2	40
Nueva Línea Nueva Maitencillo -Punta Colorada -Nueva Pan de Azúcar 2 × 220 kV, 2 × 500 MVA	2020	8	4	3	38
Nueva Línea Transmisión 2 × 220 kV Nueva Pan de Azúcar-Punta Sierra-Centella	2021	4	1	1	25

* Note: % progress is calculated based on the proportion of required reports which are completed.

found that compensation measures (compared to the number of repair measures proposed) are included more often than expected, especially considering that they should be used as a last resort (SEA, 2014). However, as discussed earlier, repair measures are not always a viable alternative to be considered before compensation, based on the nature of the projects. Usually, compensation measures are proposed in specific locations where nature has been replaced by infrastructure, especially in mining or energy projects in Chile. In these cases, the choice of compensation measures is likely a standard response where it is not possible to mitigate or repair. Further investigation would be needed to understand why compensation seems to be the preferred course of action rather that repair, considering the nature of the project, and operational and financial costs.

6. Is the monitoring of the measures implemented effective?

6.1. Methods

To address the implementation of the measures, the monitoring reports published and available to date were reviewed for the 31 projects from which the sample of EISs was drawn. The number of completed monitoring reports was determined to assess the level of progress of each project. For each monitoring report, the type of monitoring was identified as well as the indicator (which is the parameter that is being measured) that was being monitored, to determine whether they were biodiversity-related, and whether they were measuring biodiversity outcomes (which means the actual state of the biodiversity parameter). The distinction is important, as indicators are typically divided into measurements of pressure, state, or response, after OECD (1994). For example, where visitor pressure threatens a plant species, an indicator counting visitor numbers would record pressure, the number and condition of the threatened plant species would be the state, and the erection of a fence to keep out visitors a response. Whilst indicators can exist for pressure, state, and response, it is only the state indicator that shows the outcome for the biodiversity element of interest.

6.2. Results and discussion

Overall, out of 215 monitoring reports required from the total of 31 projects (those that should be presented to the authority as a requirement for construction permission), 100 reports were available for examination (47%). Table 5 shows the level of completion or progress for each project, on average the level of progress is 34% across the 31 projects that have monitoring data. The number of 'completed' reports corresponds to monitoring that has taken place and has already finished (it should be noted that that the scope and duration of monitoring programmes influence the level of completion of each report), while 'available' includes those which are completed, and those taking place over a longer term where the monitoring is still ongoing and therefore the data are only partially collected (the amount of time that the monitoring lasts has not finished yet). The information obtained from the public online database of the Superintendency of the Environment does not give the reasons why there are some reports missing (the difference between the number of reports required, and the number available).

The type of monitoring and the indicator that is being monitored was extracted from each monitoring report. Overall, out of 100 reports, 69 aimed to monitor some biodiversity-related indicator, delivering biodiversity outcomes. Whilst 31 reports included other types of indicators derived from visual inspections and studies, which were considered to be implementation indicators (Table 6).

Almost one third of the reports (31%) reported the success of the measures based on the implementation of the measures (qualitative outcomes), e.g., if the measure was carried out according to what was indicated in the monitoring planning in the EIS (methods, place, timing). Most of them relied on visual inspection-based monitoring (29%) where

Table 6
Types of monitoring that projects have implemented and the indicator that is being monitored.

	Type of monitoring	Indicators	Number of reports
Biodiversity-related indicator	Systematic fauna surveys	Richness and abundance	18
		Presence of individuals	6
		Number of individuals	2
	Wildlife observations	Presence of individuals	9
		Number of individuals	1
	Systematic flora surveys	Survival of individuals	18
		Number of individuals	5
		Richness and abundance	2
		Plant cover	2
		Number of seeds	1
		Germination and flowering	1
		Plant density	1
		Presence of individuals	1
	Systematic flora and fauna surveys	Richness and abundance	1
	Measure of habitat	Area	1
Implementation indicator	Visual inspection	Activity recorded	19
		Installation of equipment	8
		Attendance record	2
	Studies	Report delivered	2
Total			100

the activity is recorded through photographs or checklist (being the most common indicators of success of the measures), followed by the verification of the installation of devices such as bird-flight diverters or signage. However, these monitoring reports do not provide quantitative information for biodiversity as the results are based mainly in the implementation of the measure, rather that the effectiveness of the measure in terms of biodiversity outcomes.

Activities such as attendance records for worker environmental training, as well as the delivery of scientific studies carried out to generate knowledge about the component of biodiversity affected, were classified as accompanying measures in this study. Therefore, they are not expected to quantify biodiversity outcomes. They accounted for 4% of all the monitoring reports reviewed in this study.

In terms of biodiversity outcomes, 69% of the monitoring reports used a biodiversity-related indicator (quantitative outcomes). However, the outcomes on biodiversity were based on proxies for biodiversity (e.g., the most common indicators were richness and abundance for fauna (18%) and survival of individuals for flora (18%)), rather than on detailed quantification of biodiversity losses or gains. The biodiversity-related indicators tend to be species-specific as the monitoring is focused mainly on fauna and flora species, rather than habitats or ecosystems (Quétier and Lavorel, 2011; Gardner et al., 2013). For example, the monitoring reports provided data on the number of native trees planted, or the number of flora/fauna species rescued and relocated, but none reported data on the dynamics of new animal/plant communities or ecosystems created that would indicate the impacts were successfully mitigated, repaired, or compensated as a result of the implementation of the measures. There was only one monitoring report (one out of 31 projects) that quantified the residual impacts on biodiversity throughout the process that would allow a justification of a decision on whether compensation was required.

Table 7
Number of measures implemented (report available to March 9, 2022), and the number of implementation/biodiversity-related indicators proposed for each measure.

Project	Measures implemented	Implementation indicator		Biodiversity-related indicator	
	n = 100	*n* = 31	%	*n* = 69	%
Proyecto Nueva Línea 2 × 500 kv Charrúa-Ancoa: tendido del primer conductor	11	3	27	8	73
Línea 2 × 220 kV Ciruelos-Pichirropulli	6	4	67	2	33
Explotación Minera Oso Negro	4	–	–	4	100
Proyecto Parque Solar Quilapilún	4	3	75	1	25
Proyecto Santo Domingo	3	1	33	2	67
Candelaria 2030 - Continuidad Operacional	2	–	–	2	100
Proyecto Parque Eólico Aurora	1	–	–	1	100
Plan de Expansión Chile LT 2 × 500 kV Cardones – Polpaico	8	2	25	6	75
Proyecto El Espino	3	–	–	3	100
Mini Central Hidroeléctrica de Pasada Cipresillos	2	1	50	1	50
Nueva Línea 2 × 220 kV Encuentro-Lagunas	4	2	50	2	50
Ampliación y Modernización Planta Enaex S.A. La Serena	2	–	–	2	100
Parque Fotovoltaico Santiago Solar	3	–	–	3	100
Planta Desalinizadora de Agua de Mar para la Región de Atacama, Provincias de Copiapó y Chañaral	2	–	–	2	100
Parque Eólico Malleco	1	–	–	1	100
Embalse de Regadío Las Palmas	2	–	–	2	100
Proyecto Hidroeléctrico Embalse Digua	2	2	100	–	–
Minicentrales Hidroeléctricas de pasada Aillín y Las Juntas	6	4	67	2	33
Minerales primarios Minera Spence	1	–	–	1	100
Infraestructura Complementaria	4	1	25	3	75
Proyecto mejoramiento de la generación, transporte y disposición de residuos arsenicales de división el teniente	1	–	–	1	100
Planta Fotovoltaica Santa Rosa	2	–	–	2	100
Parque Eólico Cabo Leones III	3	1	33	2	67
Concesión Vial Puente Industrial	3	–	–	3	100
Mirador de Lo Campino	2	–	–	2	100
Línea de Transmisión Lo Aguirre - Alto Melipilla y Alto Melipilla – Rapel	6	5	83	1	17
Nuevas Líneas 2 × 220 kV entre Parinacota y Cóndores	2	–	–	2	100
Estudio de Impacto Ambiental Proyecto Salares Norte	3	–	–	3	100

(*continued on next page*)

Table 7 (*continued*)

Project	Measures implemented	Implementation indicator		Biodiversity-related indicator	
	n = 100	*n* = 31	%	*n* = 69	%
Estudio Impacto Ambiental Circunvalación Oriente Calama	2	–	–	2	100
Nueva Línea Nueva Maitencillo -Punta Colorada -Nueva Pan de Azúcar 2 × 220 kV, 2 × 500 MVA	4	1	25	3	75
Nueva Línea Transmisión 2 × 220 kV Nueva Pan de Azúcar-Punta Sierra-Centella	1	1	100	–	–

Twenty-nine out of 31 projects reported biodiversity outcomes at some level, as they proposed at least one biodiversity-related indicator (Table 7). Seventeen of these were entirely focused on biodiversity-related indicators, delivering the results in terms of biodiversity outcomes, even when they did not quantify biodiversity, as discussed above.

Although the mitigation hierarchy effectiveness depends on the full implementation of the measures (Sánchez and Gallardo, 2005; Drayson and Thompson, 2013; Morrison-Saunders et al., 2021), it is not possible to assess the effectiveness of the measures implemented without monitoring information about the biodiversity outcomes targeted by the intervention (Panfil and Harvey, 2016). Measurable and quantitative targets should be stipulated in the monitoring plan in the EIS, as it is established by the law (MMA, 2012). However, it was found that 31% of the monitoring are reporting qualitative outcomes. Measurable and quantitative targeted monitoring is essential for verifying the effectiveness of the mitigation measures (Sánchez and Gallardo, 2005; Drayson and Thompson, 2013; Morrison-Saunders et al., 2021). This research suggests monitoring can be improved and give greater focus to the quantification of the biodiversity outcomes resulting from the mitigation measures.

7. Conclusion and recommendations

This study evaluated the extent to which biodiversity is being protected from impacts of development projects by the Chilean environmental legislation implemented in 2014. The country's policy framework includes legislation to deliver the mitigation hierarchy within its EIA System. However, in practice the implementation of the mitigation hierarchy and the monitoring of quantifiable biodiversity outcomes remains challenging.

This review of all information available up to 2022 showed projects have a tendency to use more compensation measures than would be expected from the implementation of the mitigation hierarchy. There is limited use of repair measures, and avoidance measures were rarely proposed. This bias towards compensation may indicate a poor use of the mitigation hierarchy (Glasson and Therivel, 2019). However, in some contexts, for example mining projects, where the impacts on the area affected cannot be avoided and repaired, as the projects cannot be relocated or reduced in scale, compensation may be the only option available. Other project types, such as, energy, hydraulic, sanitation, housing, and others, could potentially make a greater effort to include measures that avoid impacts on biodiversity.

Thus, the inverted mitigation hierarchy pyramid expected based on theory and guidance, is not relevant to all project types. Further research is needed to determine the underlying causes for the preponderance of compensation measures in the majority of the projects in this study, to determine whether this is due to financial and logistical expedience. At the time of writing, there was no mandated limit on how much to compensate, and for most projects compensation seemed to be the preferred option (where repair was not feasible), therefore some of these factors might be influencing the decision on the level of compensation.

This study has also shown that misclassification of the measures throughout the mitigation hierarchy whilst present, is not a major issue in relation to biodiversity outcomes. Nevertheless, practice can be improved to ensure that misclassification does not subvert the correct use of the mitigation hierarchy.

Regarding EIA-related biodiversity monitoring, this study identifies some missing reports that either have not taken place yet or have not been submitted to the public database. A subsequent long-term assessment would be required to understand whether this was evidence of omission, or simply a facet of timing. Nevertheless, some measures were being claimed as successful based purely on implementation (the verification of the activity being conducted), rather than on evaluation of biodiversity outcomes.

Despite many projects delivering biodiversity-related indicators, there was rarely an attempt to quantify biodiversity outcomes through all the levels of the mitigation hierarchy that would allow the measurement of net gains (Drayson and Thompson, 2013; Ekstrom et al., 2015; Gelot and Bigard, 2021). Additionally, the focus was on selected elements of biodiversity which paint a partial picture of the outcomes, without considering the wider consequences for ecosystems (Gelot and Bigard, 2021; Boileau et al., 2022). Even though it depends on the component of biodiversity whether it can be mitigated, repaired, or compensated, the measures should aim to conserve unique ecosystems or threatened species that depend on specific conditions in their environment. The introduction into the national legislation of the 'Methodological guide for the compensation of biodiversity in continental terrestrial and aquatic ecosystems' (SEA, 2022b), may lead to some improvements in quantification of all the components of biodiversity, allowing the achievement of biodiversity net gain.

CRediT authorship contribution statement

Rocío A. Cares: Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing – original draft, Writing – review & editing, Visualization, Supervision, Funding acquisition. **Aldina M.A. Franco:** Conceptualization, Validation, Formal analysis, Writing – review & editing, Visualization, Supervision, Project administration. **Alan Bond:** Conceptualization, Methodology, Validation, Formal analysis, Writing – review & editing, Visualization, Supervision, Project administration.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Acknowledgements

The first author gratefully acknowledges ANID (Agencia Nacional de Investigación y Desarrollo Chile) - Scholarship ID 72200153 for the support to this research.

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